



HANDBOOK
OF
OPERATION AND MAINTENANCE
FOR THE
AAF MODEL A-25 AIRPLANE

AAF TECHNICAL TRAINING SCHOOL
CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION
ST. LOUIS PLANT

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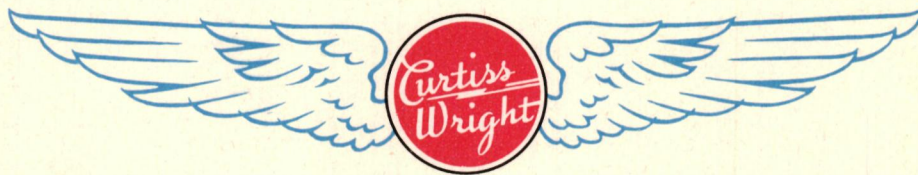
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RESTRICTED

TECHNICAL TRAINING HANDBOOK
OF
SERVICE INSTRUCTIONS
FOR THE
MODEL A-25A AIRPLANE
POWERED WITH WRIGHT MODEL R-2600-8 ENGINE



Manufactured by

CURTISS-WRIGHT CORPORATION, AIRPLANE DIVISION, ST. LOUIS PLANT

Contract W535 AC-38348

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SERVICE ENGINEERING PUBLICATION NO.12
FIRST REVISION JULY 15, 1943

RELEASED FOR
ARMY AIR FORCE TRAINING COMMAND
BY
THE CURTISS-WRIGHT CORPORATION, AIRPLANE DIVISION, ST. LOUIS PLANT

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SUSTINEO ALAS

"I Sustain the Wings"

"Those two Latin words beneath a golden urn in which reposes three plumes are the literal motto of THE AIR FORCES TRAINING COMMAND. Many an Air Force enlisted man cannot translate Latin, but his heart translates the meaning —

"I SUSTAIN THE WINGS."

"I am the Air Force Technician who makes it possible for flyers to be heroes and heroes to be flyers. I drill and work, and fight. I work that others may fly and fight. I fight that I may work to keep them flying. I am the mechanic, the machinist, the radio man, the armorer, the weather observer, the gunner, the instrument man. I'm a technician, but I fight like a Commando.

"I am one of these three plumes signifying an unbeatable trio. The plane, the air crew, the ground crew, each indispensable to the other two. Without me the plane would be a motionless machine, the pilot a helpless gladiator.

"When I trained, I chafed at the constant stream of repetition of routine, but now I realize I was learning to act on instinct. I griped at scrubbing and shining and cleaning, but now I realize neatness means a clean job of every task. An unbuttoned pocket seemed trivial, but now I know a forgotten button might be a forgotten cotter key and that forgotten key might mean a plane destroyed and a crew killed. Because of strict training I am good, and I know I'm good.

"The folks at home may never know how important I am, the Public may never see my name in print. I am the plodding line-man of modern football. I make long runs possible for All-Americans. I am the blocker that never carries the ball.

"But that pilot there knows me. He knows when he climbs aboard she sits ready. He knows those motors are perfect; the radio, his ears; the instruments, his eyes. That bombardier knows his hits are going to be perfect. And when they come back there is something in their handshake no newspaper could describe, no medal could equal. It is the grip of men whose lives depend on me."

SUSTINEO ALAS

Reprinted from the Jefferson Barracks "HUB" • Pvt. William J. Menteer
Second District, Army Air Forces, Training Command

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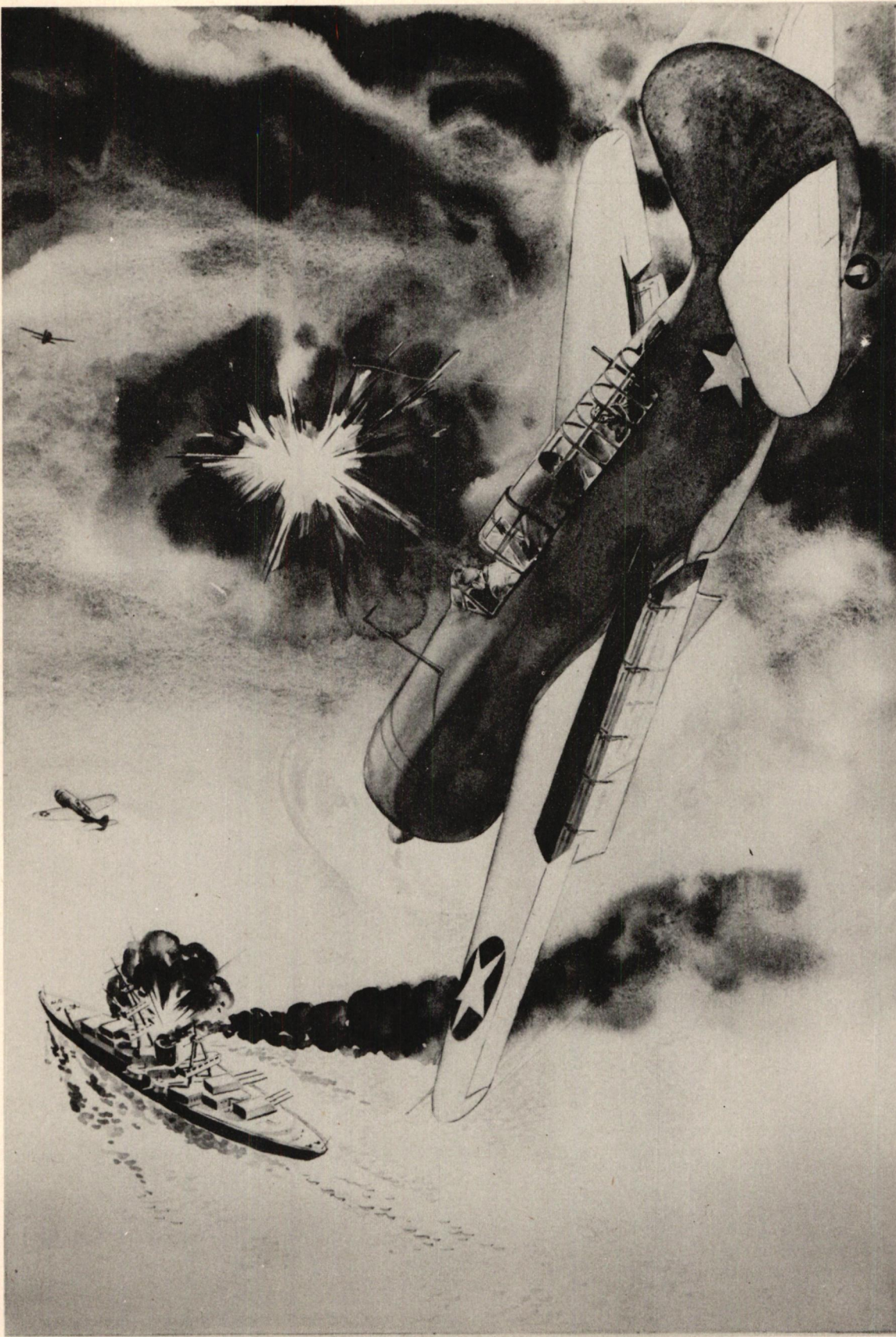
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FOREWORD

This Handbook contains the basic course of instruction for the Army Air Force Training School conducted by the St. Louis Plant of the Curtiss-Wright Corporation on the AAF Model A-25A Dive Bomber Airplane.

Subject to approval of the Army Air Force Training Command, each student attending the school will receive a copy of this Handbook for his permanent possession while in the Service. By this plan, each student will have available the more important items of service and maintenance information applying to the A-25A Airplane. Most of the individual notebook work usually required will thus be eliminated, to the end that the major portion of the student's time in the school can be devoted to actual shop instruction of a practical nature.

It is strongly urged that each student apply the maximum possible amount of his spare time to a study of this Handbook. There are many systems and mechanisms in the airplane, some of them quite complicated. A thorough understanding of them will require much study.

Remember, the proper maintenance of these airplanes in service depends upon YOU; it's up to YOU to

"KEEP 'EM FLYING"



Figure I - The A-25A Airplane

Section I

GENERAL DESCRIPTION



1. General.

The A-25A Airplane is a single-engine, two place, attack and bombardment plane. Of all-metal construction, it has an over-all span of 49 feet, 8-5/8 inches and an over-all length of 36 feet, 9 inches (fig. 2-1). It is powered by a Wright "Cyclone" 14-cylinder, double-row radial, air-cooled engine, model R-2600-8. This engine is rated at 1500 hp at 2400 rpm from sea level to 6700 feet altitude; and 1350 hp at 2400 rpm at 13,000 feet altitude. The "take-off" rating is 1700 hp at 2800 rpm for five minutes. Propulsion is by a Curtiss Electric, constant-speed, three-blade propeller, 12 feet in diameter.

Fuel capacity with the all metal fuselage tank is 290 U.S. gallons (241 Imperial gallons) and, with the self-sealing fuselage tank, 308 U.S. gallons (256.7 Imperial gallons). Using an auxiliary tank adds 130 U.S. gallons (108 Imperial gallons). The oil tank holds 25 U.S. gallons (20.8 Imperial gallons).

2. Wings.

The wing proper consists of right and left sections which join to form the center panel of the assembly, right and left outer panels and right and left wing tips.

The center panel, which forms the floor of the pilot's cockpit, contains two 100-gallon, self-sealing fuel tanks, four machine guns, the hydraulically-operated landing gear and bomb racks. All of these items are evenly divided between the right and left sections of the center panel. Split-flaps, hydraulically controlled and of all-metal construction, are attached to the trailing edge.

Adjacent to the flaps, and attached to the trailing edge of each outer panel, are the ailerons. The skin of the upper side of this device is metal, while the lower surface is fabric covered. Dynamically and statically balanced, they are operated in the conventional manner, through interconnected control cables. A trim tab is attached to the left aileron, a balance tab to the right. Incorporated into the leading edge of the outer panels are slats - right and left, respectively, which operate automatically in conjunction with the operation of the main landing gear.

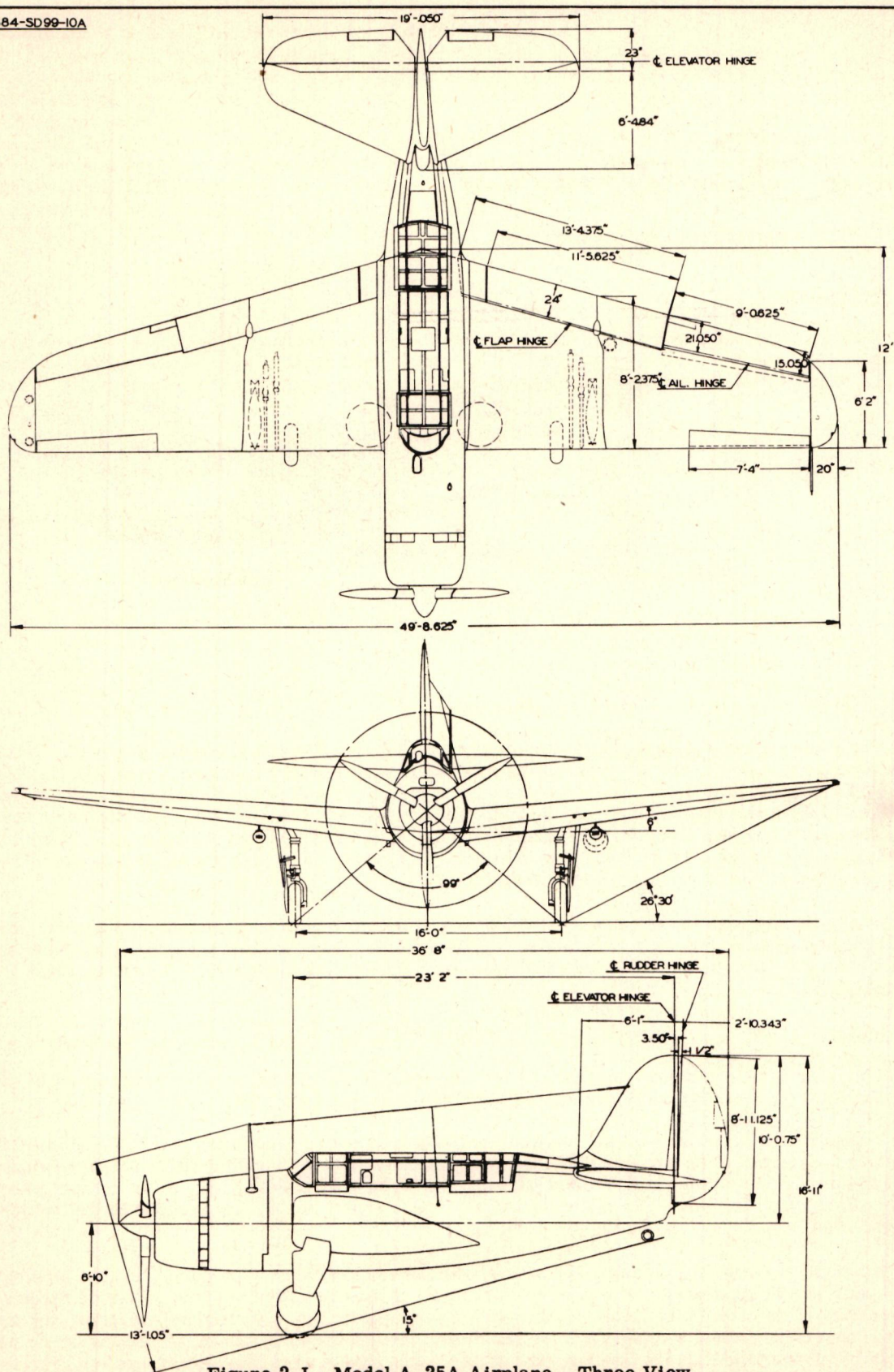


Figure 2-I - Model A-25A Airplane - Three View

3. Fuselage.

The fuselage, of semi-monocoque construction, embodies transverse frames and longitudinal stringers, covered with smooth aluminum alloy sheeting. It contains the pilot's cockpit with its complement of controls; the bomb bay, capable of holding two 500-pound or one 1000-pound bomb; and the rear cockpit with its revolving gun turret. Both cockpits are completely inclosed by a canopy, which extends, parallel to the longitudinal axis of the ship, along most of the length of the fuselage. It is faired and streamlined into the general contour of the ship, and while it protects the crew from the weather, it offers no obstruction to vision since the areas over each cockpit are built up almost wholly of plexiglass, a transparent, plastic material. Access to the ship is accomplished by moving the two hatches immediately over the cockpits, either forward or aft, as the case may be. A retractable tail wheel is built into the fuselage, directly under the empennage.

4. Empennage.

The horizontal and vertical stabilizer are constructed entirely of metal. However, the movable parts of the empennage, consisting of elevators and rudder, are metal frames covered with fabric. Trim and balance tabs are built into the rudder as well as the elevators.

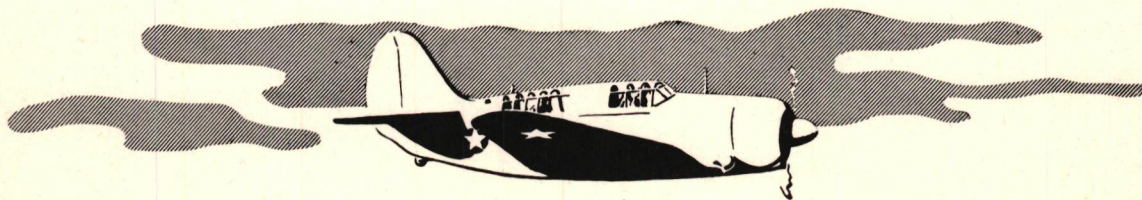
5. General Specifications.

The principal dimensions, areas, and related data for the airplane are as follows:-

Span	49 feet, 8.625 inches
Root chord	12 feet, 0.0 inches
Tip chord	5 feet, 2.0 inches
Mean aerodynamic chord	9 feet, 1.3 inches
Root section	N. A. C. A. 23017
Tip section	N. A. C. A. 23009
Length, over-all (thrust line level)	36 feet, 8.0 inches
Height, over-cabin (thrust line level)	10 feet, 10.0 inches
Height, over-tail (thrust line level)	10 feet, 11.0 inches
Height, over-propeller (three-point position)	15 feet, 2.0 inches
Propeller ground clearance (thrust line level)	10.0 inches
Ground angle, approximate	15 degrees
Wheel tread	16 feet, 0.0 inches
Wing area, total	422.0 square feet
Aileron area, total	26.6 square feet
Upper flap area, total	44.3 square feet
Lower flap area, total	51.3 square feet
Fin area	26.5 square feet
Stabilizer area	79.6 square feet
Rudder area	19.2 square feet
Elevator area, total	27.8 square feet

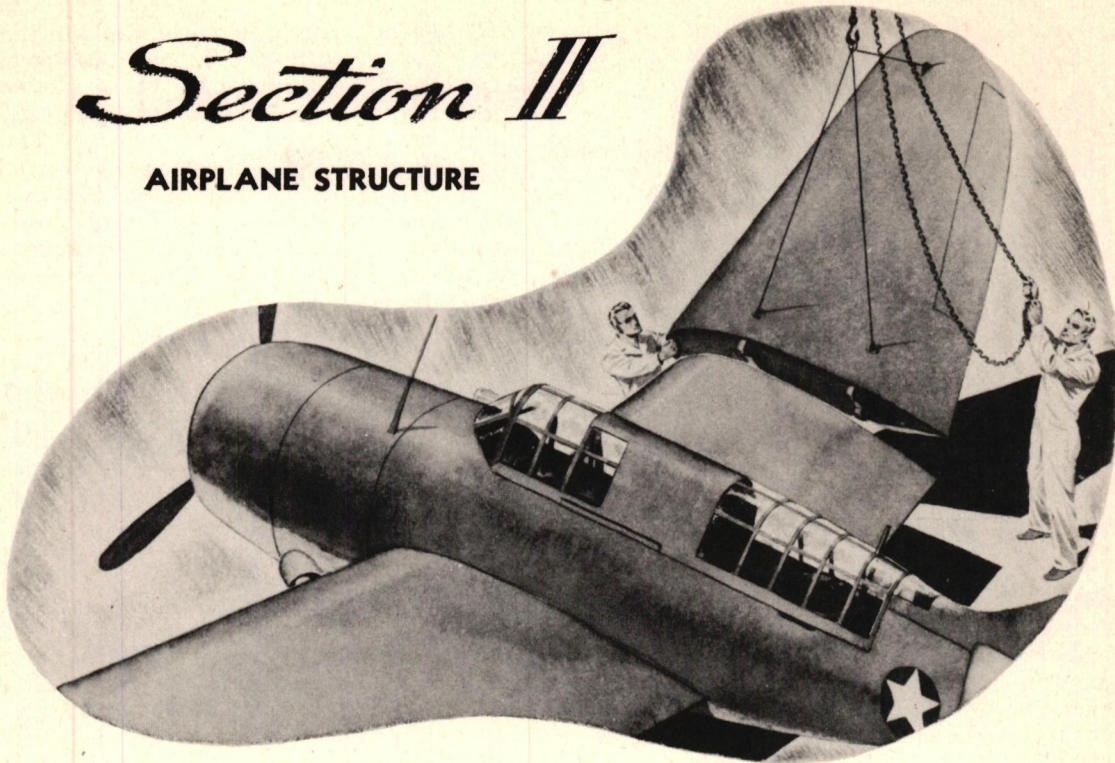
6. Weight.

The net weight empty is approximately 10,000 pounds. Refer to chapter XXI for more pertinent data on this subject.



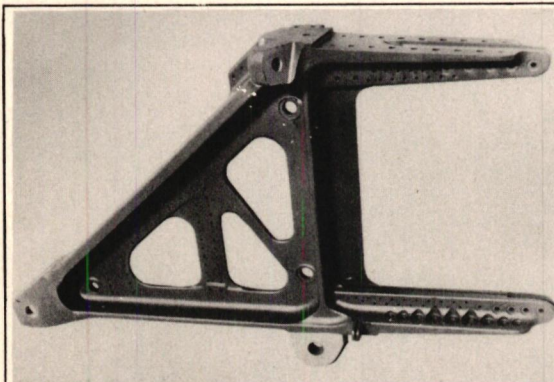
Section II

AIRPLANE STRUCTURE



1. Fuselage.

The A-25A fuselage is an all-metal, flush-riveted structure, constructed in three vertically spliced sections. There are twenty-three bulkheads including the fire wall in the fuselage. The bulkhead stations are measured in inches starting from the fire wall. Some are of the "U" channel type; others are built-up "I" beam type. These bulkheads are made of 24ST aluminum alloy material. The four most aft bulkheads carry the mechanism to operate the retractable tail wheel and tail wheel door.



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Figure 1-II - "A" Frame

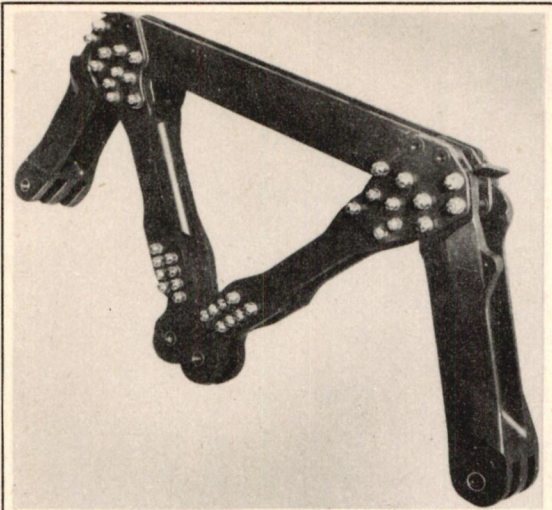
The longerons are heavy longitudinal members which are depended upon to carry a major portion of the fuselage loads. The longerons are fastened to the bulkheads, engine mount fittings, and stabilizer fittings. The lower longerons are split to allow for the wing recess.

Stringers are used to stiffen the skin and carry some of the load. Stringers are made of CE-7062 stock, a bulb angle extrusion.

An "M" frame connects to the "A" frames of the center panels and carries most of the fuselage and wing loads. The turn over structure is connected to the "M" frame and to the split "I" type bulkhead at station 90.

The skin of the fuselage varies in thickness from .025 inches to .064 inches. Rivets used on the skin are A17ST, 100 degrees countersunk flush-type, and A17ST flatheads for interior parts. Some of the skin around the cabin is one-fourth inch bullet-deflecting type.

The fuselage structure cannot be altered or adjusted and little maintenance will be required on the structure, except in cases of damage caused by projectiles or forced landings. To level the fuselage, three leveling lugs are provided on the sills of the front cockpit at station 35 and station 52. An ordinary spirit level may be used on these sills.



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Figure 2-II - "M" Frame

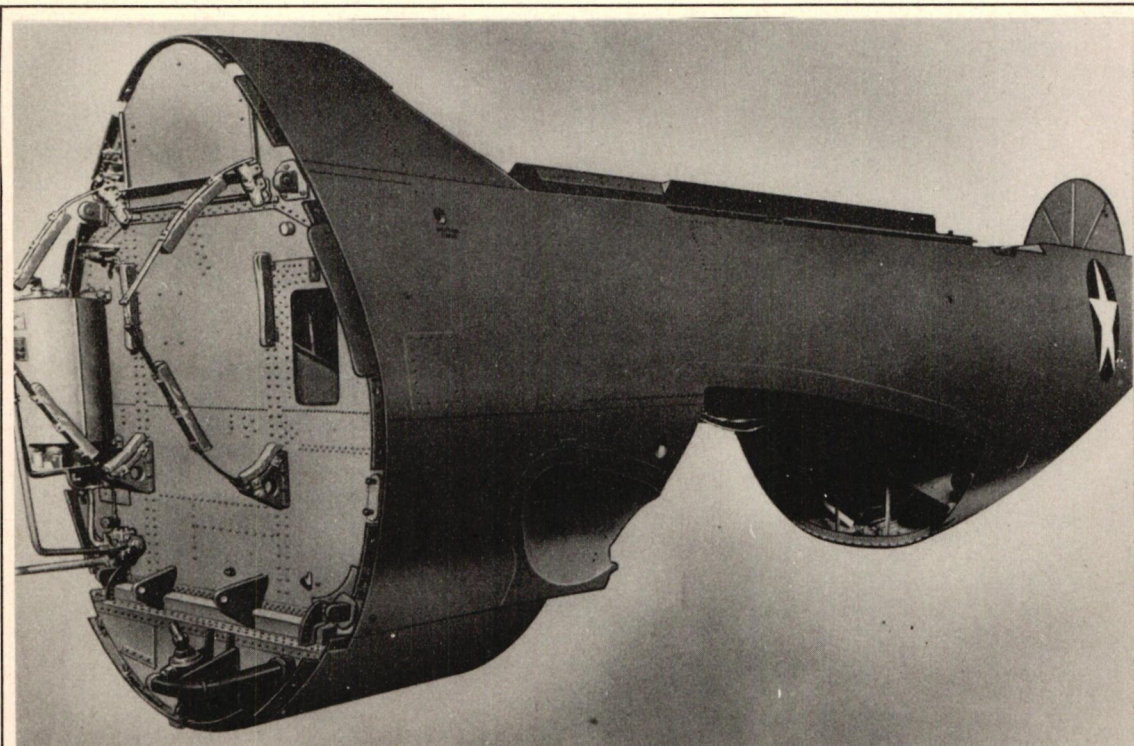
systems are not connected together in any way, but are closely related in function.

a. Bomb Bay and Bomb Bay Doors.-

(1) General.- Provision is made for carrying two 500-pound bombs or one 1000-pound bomb, or one 1600-pound bomb. Three conventional racks are mounted inside the bomb bay, parallel to the center line of the airplane. Each of the outside racks accommodates a 500-pound bomb. The center rack accommodates either the 1000-pound bomb or the 1600-pound bomb. These bombs and bomb racks are enclosed in the center panel bomb bay by the bomb bay doors during normal flight operation.

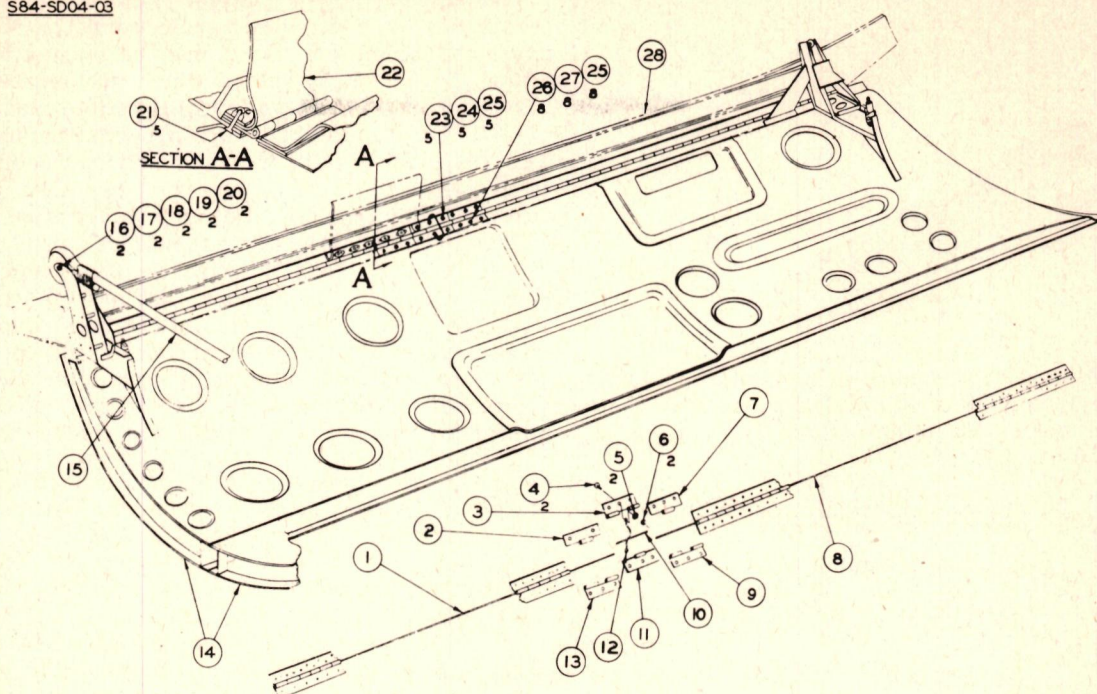
The bomb bay doors and bomb displacing gear are operated hydraulically. The bomb door system opens and closes the bomb bay doors, as required for release of bombs carried internally. The bomb displacing gear system swings released bombs clear of the airplane, and the gear automatically retracts. The two

(2) Operation of Bomb Bay Doors.- The hydraulic system consists of a bomb door control lever, one bomb door control valve, two emergency dump valves, four strut assemblies, and the necessary lines and fittings. To open the doors, the control handle, projecting through a slot in the floor at the left of the pilot's seat is pushed forward. The control handle is connected to the bomb door control valve which is located on the underside of the cockpit floor. As the handle is pushed forward, the plunger in the control valve is pulled out, allowing the hydraulic fluid to flow through the control valve from the main system to the tops of the four strut assemblies, forcing the pistons in the struts outboard, opening the bomb doors. When the bomb doors are to be closed, the handle of the hydraulic control lever is pulled back, thus moving the plunger into the body of the valve, and allowing hydraulic fluid from the main system to enter the outboard ends of the struts, retracting the bomb doors.



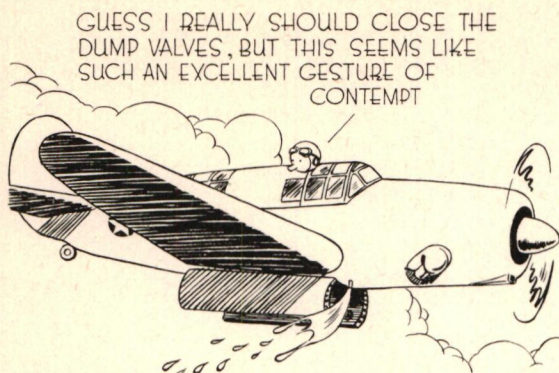
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Figure 3-II - Fuselage



<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Hinge Pin	S84-04-078-11
2	1R	Hinge Leaf	S84-04-078-5
3	1R	Hinge Leaf	S84-04-078-7
4	2	Bolt	1103-D-S7A
5	2	Washer	AN960-D10
6	2	Nut	AAF365-1032
7	1R	Hinge Leaf	S84-04-078-9
8	1	Hinge Pin	S84-04-078-10
9	1R	Hinge Leaf	S84-04-078-503
10	1	Hinge Pin	S84-04-078-12
11	1R	Hinge Leaf	S84-04-078-8
12	1	Jumper	NAF1065-F6
13	1R	Hinge Leaf	S84-04-078-6
14	1L & 1R	Bomb Door Assembly	S84-06-504-100
15		Shock Cord Assembly (Ref.)	S84-04-738
16	2	Bolt	AN5-14
17	2	Sleeve	S84-06-504-13
18	2	Washer	AN960-A516
19	2	Nut	AN310-5
20	2	Cotter Pin	AN380-C2-3
21	5	Bolt	1103-D-S-10
22		Scuff Plate Assembly (Ref.)	S84-04-537R
23	5	Bolt	1103-D-S-6A
24	5	Washer	AN960-C10L
25	13	Nut	NAF1137-1032
26	8	Bolt	1103-D-S-5A
27	8	Washer	AN960-A10
28		Lower Center Longeron (Ref.)	S84-04-509R

Figure 4-II - Bomb Door Installation



the emergency opening of the bomb bay doors in this manner, unless there is some hydraulic pressure in the system. It is advisable, however, to place the control lever in the "OPEN" position before the dump valves are opened. No emergency method is provided for closing the bomb bay doors.

(3) Emergency Operation.-

For emergency operation, when hydraulic pressure cannot be obtained, the bomb bay doors may be opened by opening the two dump valves which are located on the cockpit floor at the left of the pilot's seat. This will allow the struts to drain, permitting the pistons to move freely, and the bomb bay doors will be opened by a shock cord arrangement which is always under tension. The dump valves should be closed immediately after the doors open to prevent excessive loss of hydraulic fluid, which will drain outside the airplane as long as the valves are open. The position of the bomb door control lever and valve will have no effect upon

(4) Removal of Bomb Bay Doors.-

- (a) Open bomb bay doors.
- (b) Operate flaps to bring hydraulic pressure to zero.
- (c) Disconnect actuating cylinder piston rods and bungee cords.
- (d) Remove cable on left door which operates safety latch on bomb rack.
- (e) Remove short hinges at center of bomb door hinge line.
- (f) This will reveal that piano hinge wire is in two pieces.
- (g) Using locking pliers and a hammer, pull wire out far enough to chuck the end of wire in electric drill.
- (h) Using drill in slow speed, pull halves of wire out of hinge.

Installation is the reverse of disassembly.

b. Bomb Displacing Gear.-

(1) Operation of the Bomb Displacing Gear.- The bomb displacing gear for the 1000-pound bomb or the 1600-pound bomb consists of two single auxiliary arms, while one doubled (forked) auxiliary arm is required for each 500-pound bomb. The change in the displacing gear from the 1000 or 1600-pound bomb installation to the two 500-pound bomb installation requires the removal of the single auxiliary arms, arm assembly S84-70-532, from the two main displacing arms S84-70-584, and installations of double (forked) auxiliary arms, arm assembly S84-70-526. Each main displacing gear arm is attached to the auxiliary arm by three bolts. The main displacing gear arms are pivoted to fittings attached to the fire wall and each is connected to an actuating strut operated hydraulically by a control valve. When the bombs are suspended from the bomb racks and the displacing gear is in the retracted position, the adjustable ends of displacing gear are engaged with the trunnions of the bombs. The displacing gear control valve levers are placed in the inboard position, and the main shut-off valve then opened. The plunger of each control valve is now in the extended position, thereby applying hydraulic pressure through the top ports of the actuating struts. The displacing gear, however, is prevented from extending by the bombs themselves, until they are released. When the bombs are released, the actuating struts force the displacing gear immediately to the full extended position to swing the bombs clear of the airplane. When the displacing gear attains the fully extended position, it trips the dead-center bell crank of each valve control mechanism to place the valve plungers in the retracted position. With the plungers in this position, fluid under pressure from the main hydraulic system is directed through lines to the bottom ports of the actuating struts to retract

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Section II

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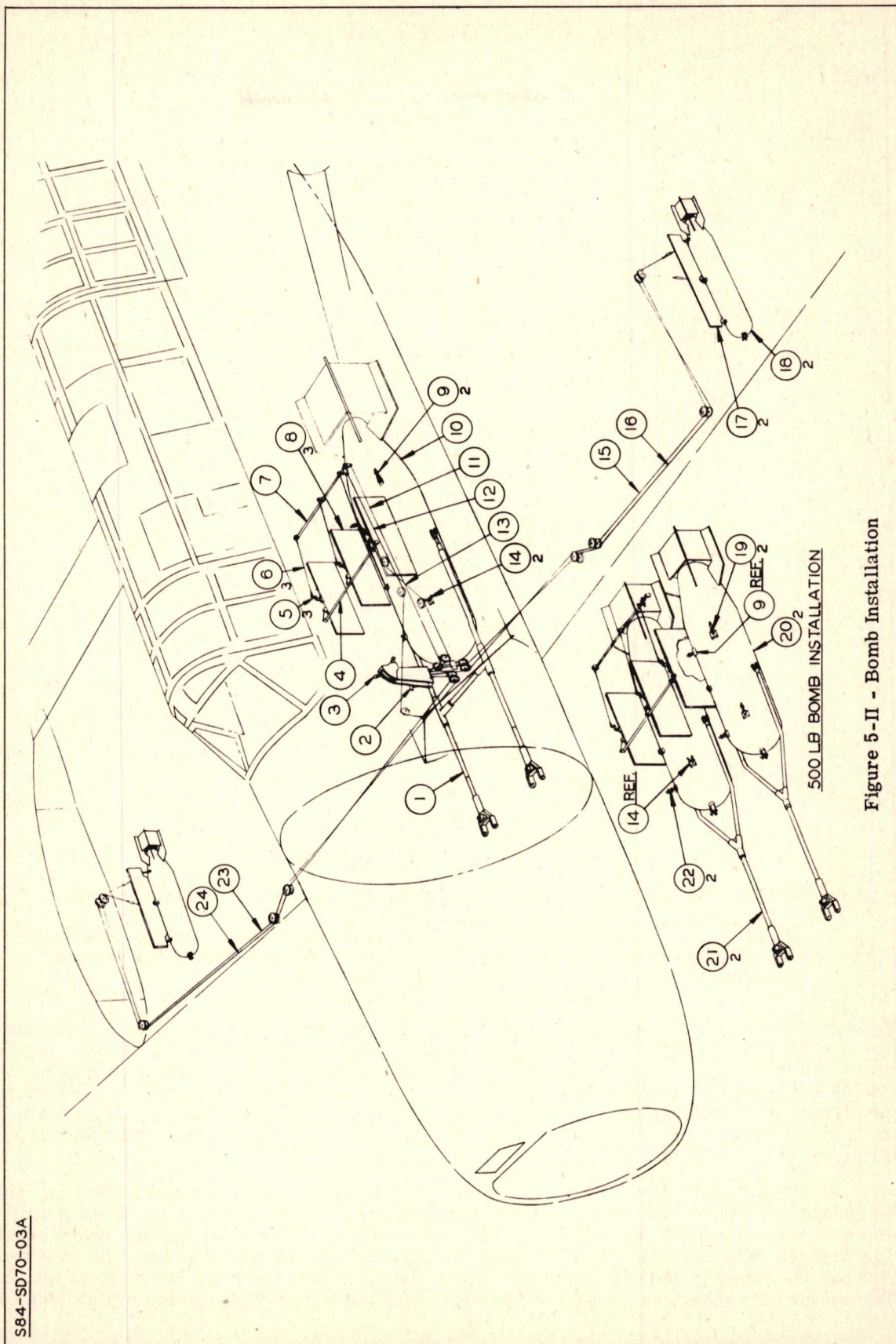


Figure 5-II - Bomb Installation

PARTS LIST - BOMB INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	1000-lb Bomb Displacing Gear Assembly	S84-70-532
2	1	Emergency Salvo Release Handle	S84-70-549-2
3	1	Bomb Release	B.O.179000 Mark IV
4	3	Bell Crank	S84-70-717
5	1	Arming Tube Assembly	S84-70-583
6	3	Cable Assembly	S84-70-564-10
7	1	Bomb Release Lock Assembly	S84-70-585
8	3	Bomb Rack	B.O.328758 Mark 51-7
9	2	Sway Brace	S84-70-536-3
10	1	1000-lb Bomb	B.O.227487-A Mark V B.O.227488-A Mark IX B.O.227489-A Mark XIII B.O.227479 Mark VII
Alternates			
11	1	Bomb Release Cable Assembly	S84-70-549-5
12	1	Bomb Control Cable Assembly	S84-70-564-6
13	1	Arming Cable Assembly	S84-70-564-9
14	2	Sway Brace	S84-70-732
15	1	Release Cable Assembly	S84-70-564-1
16	1	Arming Cable Assembly	S84-70-564-3
17	2	100-lb Bomb Rack (Wing)	
18	2	100-lb Bomb-General Purpose Bomb 100-lb AN-M-30	Air Corps H 3934768
19	2	Sway Brace (Rear)	S84-70-536-1
20	2	500-lb Bomb	B.O.227490-A Mark III * Mod. I B.O.264692-A Mark XII-I B.O.227480 Mark XI-I B.O.227491-A Mark IX
Alternates			
21	1L & 1R	Displacing Gear Assembly	S84-70-526
22	2	Sway Brace	S84-70-764 **
23	1	Release Cable Assembly	S84-70-564-2
24	1	Arming Cable Assembly	S84-70-564-4

Effective on airplanes No. 41-17774 through No. 41-18803.

* B.O.301092 AN-MK33 1000-pound armor piercing bombs may be substituted for 500-pound bombs in both outboard racks.

** When the 1000-pound bombs are carried, the S84-70-764 sway braces are replaced with S84-70-960.

the strut pistons and the attached displacing gear. As the arms of the gear attain their fully retracted position, they engage the spring-loaded "UP" latches and are locked in the retracted position, until released manually by moving the latch levers inboard. A mechanical control is provided for each valve, but it is utilized in loading the bombs and not for normal operation of the displacing gear. The main displacing gear arms, in swinging down, open two small doors between the fire wall and bomb bay doors. The doors close automatically by spring action when the gear is retracted.

(2) Release of Bombs. - Three switches are provided on the armament switch box for selecting the fuselage bomb or bombs to be dropped. The switches and their positions of operation are marked on the panel. Two of the bomb selector switches control the selection of right and left 500-pound bombs, while the third selects the 1000-pound bomb. The first two switches are moved up for individual selection of these bombs, and down for salvo selection. The release of the bomb or bombs is controlled electrically by a thumb button switch located

on the upper end of the control stick. The bomb release switch, located on the pilot's stick, energizes a solenoid located in the bomb bay near the bomb rack. When the solenoid is energized, it operates the bomb release mechanism located in the bomb rack. As a safety feature, an electric switch, S84-66-537 L and R, prevents electrical release of the bombs until doors are fully open.

In an emergency, the bombs may be released manually. The manual release quadrant is located on the left side, forward of the pilot's seat. It is connected by means of cables and pulleys to a lever assembly aft of the bomb rack. The lever is fastened to the release mechanism of both bomb racks. When using this manual control, the bombs may be dropped in salvo only. On the lever assembly is a locking mechanism, used to prevent the manual bomb releasing mechanism from operating before the bomb bay doors are fully opened. A cable is fastened to the forward end of each door and a yoke secures these cables to a third cable which leads to a pin in the locking mechanism. When the doors are fully opened, the pin is withdrawn by the cable and the manual release mechanism may be operated.

The manual arming of all bombs is accomplished by the lower rear lever on the wing bomb release quadrant. The connection from the lever to the arming assembly, S84-70-583, above the bomb racks is conventional in the use of cables and pulleys. The arming mechanism allows the bombs to be released in armed or safe condition. This is accomplished by placing the mechanism in either the "ARMED" or "SAFE" position. When in the "ARMED" position, the mechanism removed the arming wire from the bomb causing it to explode when dropped. When the mechanism is in the "SAFE" position, the arming wire is not removed from the bomb, and the bomb does not explode when dropped.

Provisions are made for the pilot and gunner to observe the bombs and the condition of the arming mechanism. Two lights are located in the bomb bay and visibility is afforded through plexiglass windows in the pilot's floor and in the aft cockpit floor. The two lights are controlled by a switch in the armament switch box. Mirrors are used in the bomb bay to direct the line of sight at nose and tail arming wires. The mirrors are adjusted manually with the bombs in place.

c. Armor Plate. -

(1) Front Cockpit. - Four pieces of armor plate, one piece of bullet-deflecting skin, and one piece of bullet-resistant glass are provided for the pilot's protection.

(a) Armor plate S84-21-708 is mounted on the forward upper side of the fire wall and is .375 inch in thickness. This plate is homogeneously hardened, in accordance with B. O. Specification O.S.2380.

(b) Armor plate S84-88-550 is fastened to the aft portion of the upper turn-over structure fitting S84-21-571 affording protection for the pilot's head. The plate is .375-inch thick and is fastened to the fitting by means of bolts. The plate is face-hardened in accordance with B.O. Specification O.S. 595 (c) and the hardened surface is marked "FRONT."

(c) Armor plate S84-88-532 is fastened to the aft upper side of the forward tubes of the turn over structure. This plate is .375-inch thick and is face-hardened in accordance with Specification O.S. 595 (c). The hardened surface is marked "FRONT."

(d) Armor plate S84-88-531 is fastened to the lower aft side of the forward tubes of the turn-over structure. This plate is spliced to armor plate S84-88-532 by means of two splice ties, S84-88-535. Each splice plate is fastened to the armor plates with two bolts, one to each plate. Splash plates are fastened to the sides of plate S84-88-531. This armor plate is .25-inch thick and is homogeneously hardened in accordance with B.O. Specification O.S.2380.

(e) Bullet-deflecting skin, S84-21-632, is employed on the upper portion of the fuselage between the fire wall and the forward windshield. The skin, 25-inch thick, is formed from aluminum alloy sheet.

(f) Bullet-resistant glass S84-26-521 is mounted just inside the forward windshield and is 1.50 inches thick. The glass is mounted at approximately forty degrees to the horizontal and is sloped from forward to aft approximately parallel to the slope of the windshield.

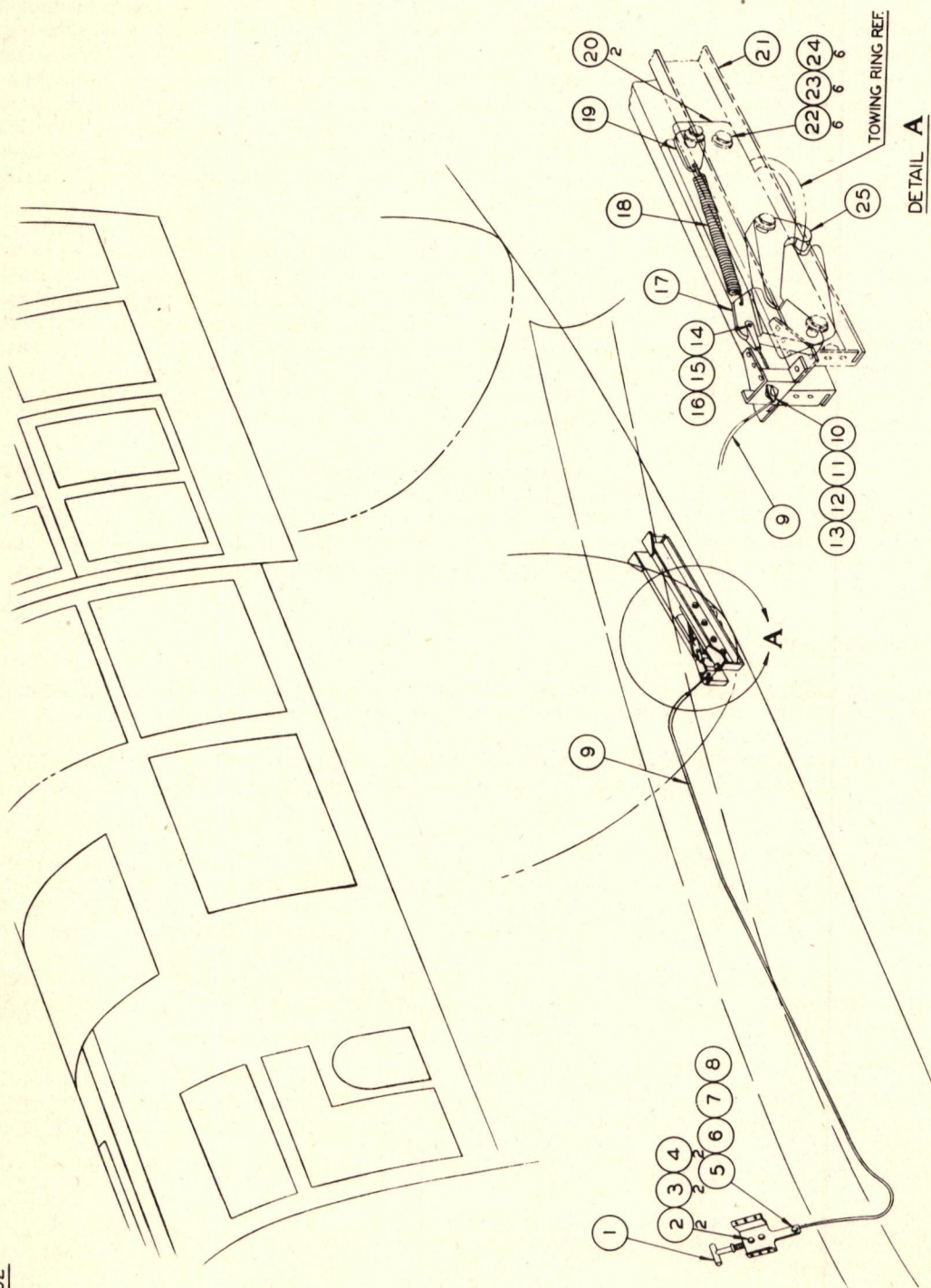


Figure 6-II - Tow Target Release

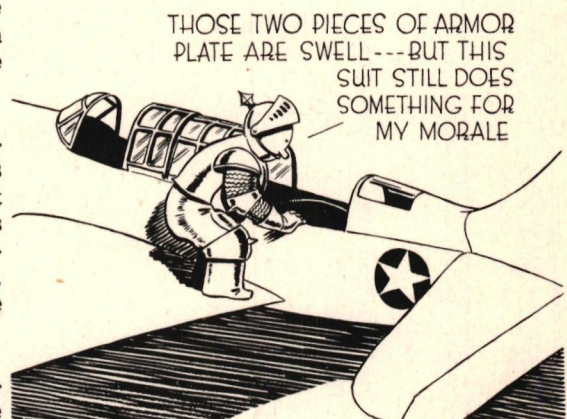
PARTS LIST - TOW TARGET RELEASE

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Handle Assembly	B.O.155982
2	2	Screw	AN520-416-8
3	2	Nut	AC365-428
4	2	Washer	AN960-416
5	1	Clamp	1042-DD-5
6	1	Screw	AN515-8-10
7	1	Washer	AN960-08
8	1	Nut	AC365-832
9	1	Cable Assembly	S84-69-614-138.0
10	1	Pulley	AN210-1A
11	1	Bolt	AN3DD-6A
12	1	Nut	NAF-1137-D1032
13	1	Washer	AN960-D10
14	1	Pin	AN393-9
15	1	Washer	AN960-D10
16	1	Cotter	AN380-C2-2
17	1	Latch	S84-69-607
18	1	Spring	S84-69-609
19	1	Clip	S84-69-610
20	2	Plate	S84-69-606
21	1	Support Installation (Ref.)	S84-69-611
22	6	Bolt	AN4-15A
23	6	Washer	AN960-D416
24	6	Nut	AC365-428
25	1	Hook	S84-69-608

(2) Aft Cockpit. - Two pieces of armor are mounted on the turret and move with the action of the turret. These plates are installed for the gunner's protection.

(a) Armor plate, S84-88-539, is mounted on brackets fastened to the turret ring. It is located on top of the turret ring and to the right of the gunner when in gunning position. This plate is .375-inch thick and face-hardened in accordance with Specification O.S. 595 Rev. (c). The hardened side is toward the outside of the turret.

(b) Armor plate, S84-88-540, is mounted on the lower portion of the turret in front of the gunner when in the gunning position. The plate is .3125-inch thick and homogenously hardened in accordance with B.O. Specification O.S. 2380.



(c) Flexible Gun. - One piece of armor plate, S84-88-555, is mounted on the sight support. A splash plate, S84-88-555-2, is bolted to the bottom of the armor plate. The armor plate is .375-inch thick and is homogenously hardened in accordance with B.O. Specification O.S. 2380.

d. Tow Target. - The tow target release assembly, S84-69-504, is located on the bottom of the fuselage between station 140 and station 158 at approximately the center of the airplane.

The tow target release catch is manually operated by a cable attached to a release handle. This handle is located in the pilot's cockpit on the left side of the airplane at fuselage station 50. The handle is pulled up to release the latch. A spring holds the latch in the "CLOSED" position.

Clean and treat all cables with rust preventive compound, Specification AN-C-52, type I or type II, grade "B."

e. Cowling.-

(1) General.- The cowling consists of two forward hemispherical segments containing the cowl flaps, and eight segments comprising the accessory compartment cowl.

(2) Accessory Compartment Cowling.- To remove the accessory compartment cowling, unlock the Dzus fasteners in the usual manner. Disconnect the oil cooler flap control rod and the quick-disconnect fitting before removing the bottom portion containing the oil cooler flaps.

(3) Forward Cowling (Speedring).- To remove the forward (speedring) cowling, first disconnect the four control rods from the flaps at quick-disconnect fittings; then loosen the three drawbolts inside the horizontal parting line at each side of the cowling. Remove the access plates to reach the two aft drawbolts. The four forward drawbolts may be reached through the front opening of the cowling. Support the lower half of the cowling; then unhook the loosened drawbolts. Lift the upper portion of the cowling free of the supporting rings; then remove it.

(4) To install the cowling, reverse the above procedure. Safety drawbolts and re-install access plates after installation.

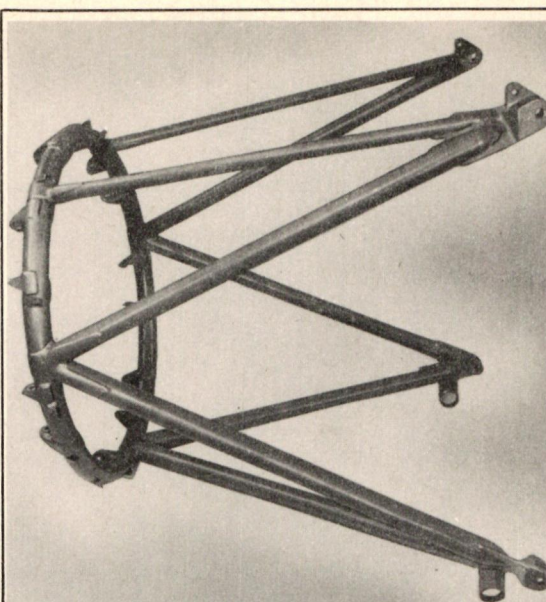
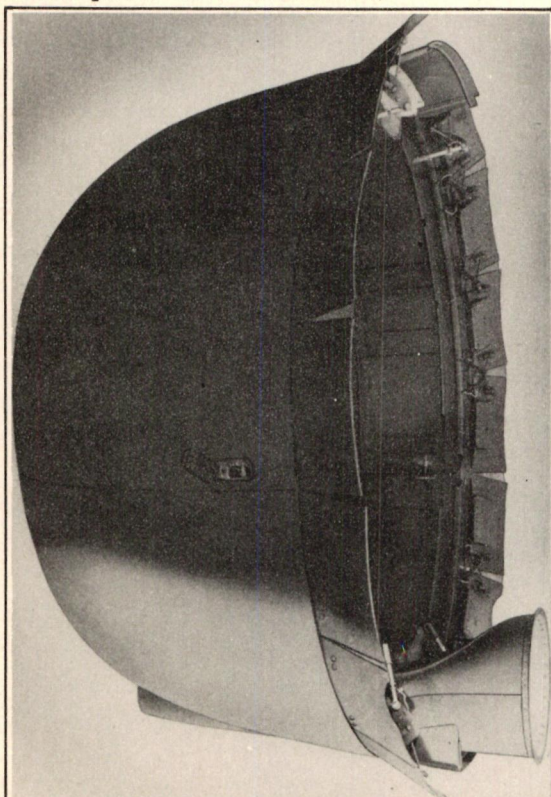


Figure 7-II - Engine Mount



884-SD29-02

Figure 8-II - Detachable Engine Cowling

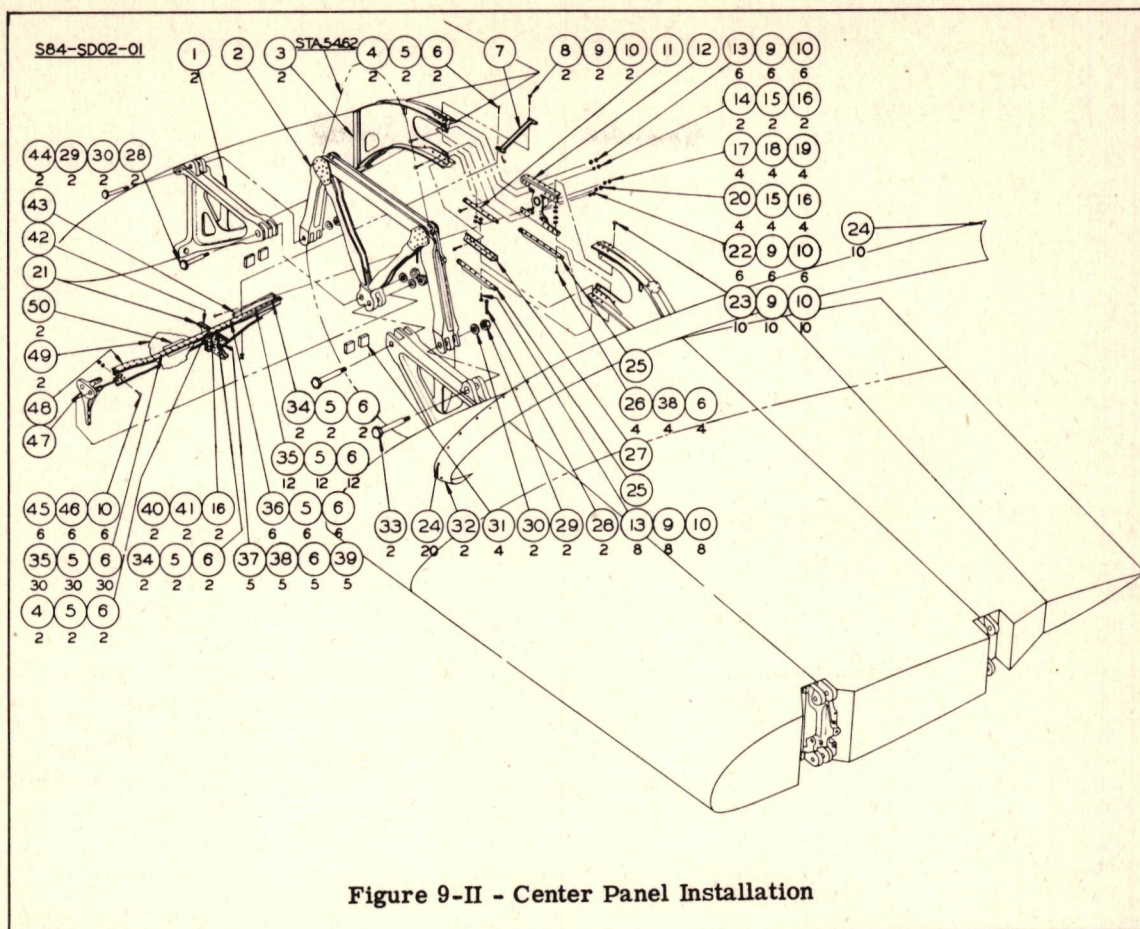
2. Wings.

a. General.- The wings are of the full cantilever low-wing type. They taper in both plan form and thickness, with leading edge straight in plan view.

The wings consist of two center panels and two outer panels which include the wing tips. The two outer panels are assembled in one unit. The wings are not adjustable and need no alignment after assembly. Six degrees dihedral is built into the wings.

b. Center Panels.- The center panels are made in two sections, but they are normally supplied already spliced together. The center section is flush-riveted on all surfaces that contact the air stream. The center panels are directly connected to the fuselage at the "M" frame and at several other points by splice plates. The construction of the center panel may readily be explained by the uses of its component parts. Beginning at the center line of the airplane, there are bomb doors and bomb racks on the under side of the center panels. On the upper side of the center panel is the cradle for the fuselage tank.

Outboard from the bomb bay are the self-sealing fuel tanks. Outboard of the wing tanks are ammunition boxes which are accessible from the top of the wing. Outboard of the ammunition



PARTS LIST - CENTER PANEL INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L & 1R	Front Beam "A" Frame Assembly	S84-04-570
2	1	"M" Frame Assembly	S84-21-780
3	1L & 1R	Rear Beam Bridge Frame	S84-04-556
4	4	Bolt	AN24-12A
5	56	Nut	AAF364-428
6	65	Washer	AN960-D416
7	1	Brace	S84-06-517
8	2	Bolt	AN6-14A
9	32	Nut	AAF365-624
10	38	Washer	AN960-D616
11	1	Flange	S84-04-553
12	1	Center Line Fitting	S84-04-565
13	14	Bolt	AN6-15A
14	2	Bolt	AN5-7A
15	6	Nut	AAF365-524
16	8	Washer	AN960-D516
17	4	Bolt	AN3-5A
18	4	Nut	AAF365-1032
19	4	Washer	AN960-D10
20	4	Bolt	AN5-10A
21	1	Splice	S84-04-600
22	6	Bolt	AN6-16A
23	10	Bolt	AN6-13A

PARTS LIST - CENTER PANEL INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
24	30	Screw	AN526-1032-10
25	2	Tie Plate	S84-04-581
26	4	Bolt	AN4-15A
27	1	Flange	S84-04-554
28	4	Cotter	AN380C4-6
29	4	Nut	AN310-16
30	4	Washer	AN960-D1616
31	4	Sponge Rubber	S84-06-501-13
32	1L & 1R	Wing Fillet Assembly	S84-23-506
33	2	Bolt	S84-04-856-2
34	4	Bolt	AN24-11A
35	42	Bolt	AN24-10A
36	6	Bolt	AN24-9A
37	5	Bolt	AN4-13A
38	9	Nut	AAF365-428
39	5	Spacer	1026-D-.375-.484
40	2	Bolt	AN5-14A
41	2	Nut	NAF1137-524
42	1	Splice	S84-04-601
43	1	Wing Center Line Bulkhead Assembly	S84-04-605
44	2	Bolt	S84-04-856-1
45	6	Bolt	AN26-22A
46	6	Nut	AAF364-624
47	1	Front Beam Center Line Splice	S84-04-564
48	1	Wing Center Line Splice Plate	S84-06-518
49	1L & 1R	Skin	S84-04-814-2
50	1L & 1R	Doubler	S84-04-814-4

tion boxes are the guns. Provision is made for the installation of two caliber .50 machine guns in each half of the wing.

Both center panels are symmetrical about the center line of the airplane. The main landing gear retracts into the bottom leading edge of the wing and is supported by a forging, attached to the front main beam.

The front main beam assembly consists of a top and bottom flange connected by a one-fourth inch web stiffened by extrusions. On the inboard end of the beam is an "A" frame forging which connects to the "M" frame of the fuselage. The truss assembly and landing gear support are riveted to the forward face of the beam.

The rear beam assembly is also of the built-up "I" beam type. A bridge frame connects the center panels together by means of a splice plate at the inboard end of the beam.

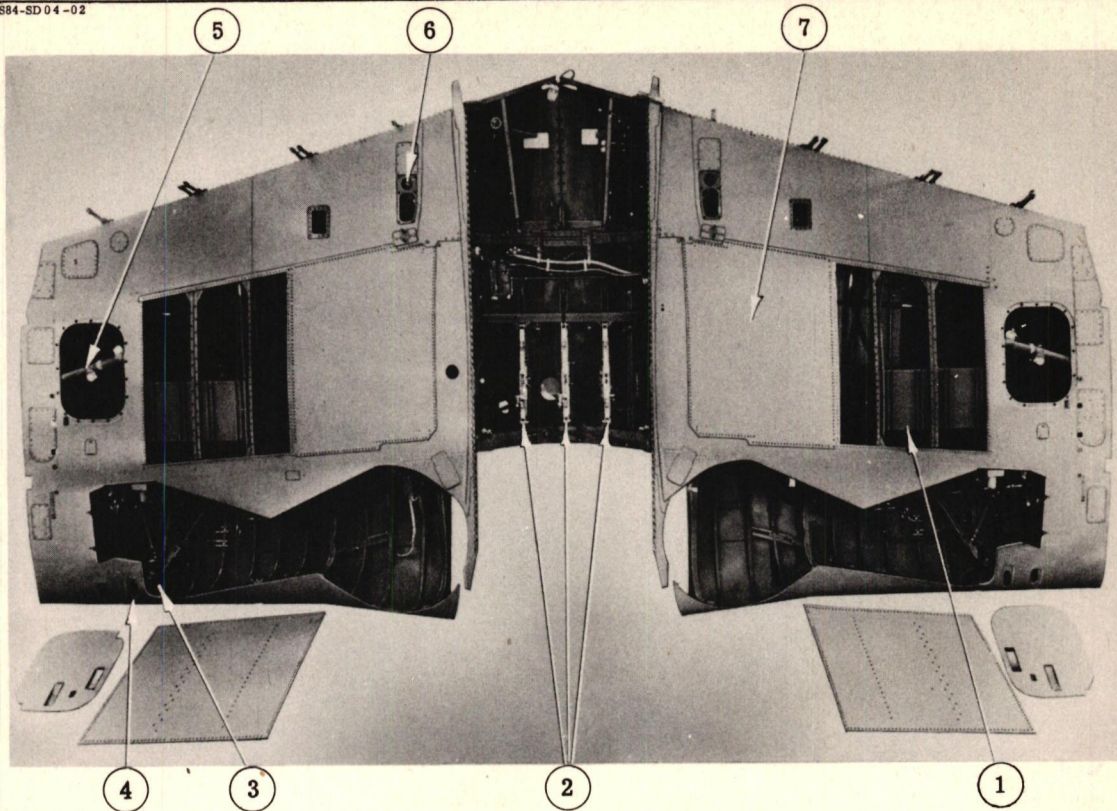
The nose and trailing edge assemblies consist essentially of bulkheads or forming ribs to carry the air loads from the skin to the main beams.

The structure of the center panels is easily accessible through the bomb doors and access doors in the bottom of the wing. Cable, tubing, and electrical conduit connections are accessible in the bomb bay and the landing gear wheel wells or through inspection doors.

c. Outer Panels.- The outer panels are rigidly connected to the inner panels and are of similar construction. They consist of panel, ailerons, slats, flaps, and the wing tips.

(1) Removal and assembly of left panel and wing tips are described below:

(a) To remove wing tip: Remove access openings at wing tip.



1. Wing Gun Ammunition Box
2. Bomb Rack Mk. XXXV-4
3. Landing Gear Wing Truss Assembly
4. Openings for Machine Guns
5. Wing Gun Mounting Post
6. Wing Fuel Tank Drain
7. Access Door to Self-Sealing Fuel Cell

Figure 10-II - Center Panel

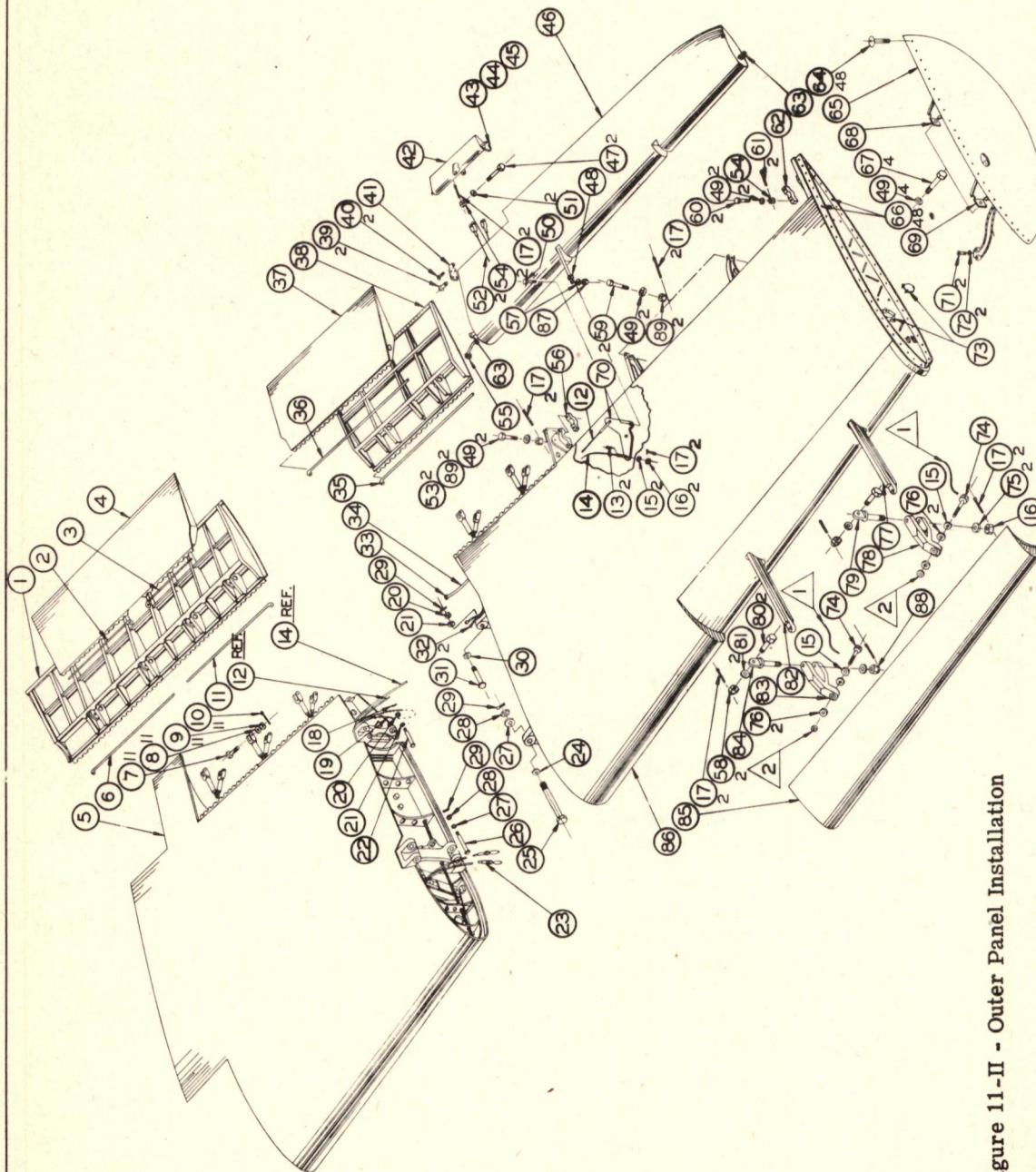


Figure 11-II - Outer Panel Installation

PARTS LIST - OUTER PANEL INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L	Lower Inner Flap Assembly	S84-08-501-2
2	1	Upper Inner Hinge Pin	S84-04-607-2-31.88
3	1	Upper Inner Hinge Pin	S84-04-607-2-56.38
4	1L	Upper Inner Flap Assembly	S84-08-501-4
5	1L	Center Panel Assembly	S84-04-501-11
6	1	Lower Inner Hinge Pin	S84-04-607-2-52.38
7	11	Bolt	AN6-16
8	11	Washer	AN960-616
9	11	Nut	AN310-6
10	11	Cotter Pin	AN380-C3-3
11	1	Lower Inner Hinge Pin	S84-04-607-2-58.44
12		Aileron Cable Assembly (Ref.)	S84-SD64-01
13	2	Bolt	AN25-14
14		Aileron Cable Assembly (Ref.)	S84-SD64-01
15	4	Washer	AN960-516
16	3	Nut	AN320-5
17	12	Cotter Pin	AN380-C2-2
18	1	Cotter Pin	AN380-C4-5
19		Aileron Trim Tab Cable and Chain Assembly (L.H. Only) (Ref.)	S84-SD64-01
20	1	Nut	AN320-12
21	2	Washer	AN960-D1216
22	1	Lower Hinge Bolt (Rear)	S84-020-1011
23		Slat Control Cable Assembly (Ref.)	S84-SD31-03
24	1	Washer	1075-DD-.102-1.203- 1.750
25	1	Bolt	S84-04-688
26	1	Lower Hinge Bolt (Front)	S84-020-1012
27	2	Washer	AN960-D1616
28	2	Nut	AN320-16
29	3	Cotter Pin	AN380-C4-6
30	1	Washer	AN960-D1416
31	1	Bolt	S84-04-689
32	2	Air Speed Hose Assembly (L.H. Only)	AN857-4D-21
33	1	Wing Tip Electrical Plug	AN3106-20-9P
34	1	Electric Conduit Assembly	S82-66-369-8AC-78
35	1	Lower Outer Hinge Pin	S84-04-607-2-50.44
36	1	Upper Outer Hinge Pin	S84-04-607-2-48.88
37	1L	Upper Outer Flap Assembly	S84-08-501-3
38	1L	Lower Outer Flap Assembly	S84-08-501-1
39	2	Screw	AN502-10-10
40	2	Screw	AN502-10-14
41	1	Housing	S84-05-578
42	1	Trim Tab Assembly	S84-05-502-1
43	1	Jumper	NAF1065F5
44	1	Screw	AN515-D8-8
45	1	Nut	NAF1137-D832A
46	1L	Aileron Assembly	S84-05-505
47	2	Bolt	AN23-9
48		Aileron Control Link Assembly (Ref.)	S84-SD64-07
49	10	Washer	AN960-D10
50	1	Bolt	AN4-12
51	2	Washer	AN960-C10
52	2	Trim Tab Rod Assembly	Breeze No. B-6-10- 1415-2
53	2	Bolt	AN3-10
54	4	Nut	AN320-3
55		Trim Tab Drive Shaft and Casing Assembly (Ref.)	S84-SD64-01

PARTS LIST - OUTER PANEL INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
56	1	Bearing Cap	S82-03-318-1
57	1	Washer	AN960-416
58	2	Nut	AN310-4
59	2	Bolt	AN3-22
60	2	Bolt	AN3-6
61	2	Cotter Pin	AN380-2C-3
62	1L	Support Cap	S84-03-530-2
63	2	Bearing	SKF-4 (Norma - Hoffman Corp.)
64	48	Screw	AN526-1032-8
65	1L	Wing Tip Assembly	S84-03-506
66	48	Plate Nut	22A21-6-02
67	4	Bolt	AN3-4A
68	1	Bracket	S84-03-709-501
69	1	Bracket	S84-03-708-501
70		Bell Crank Assembly (Ref.)	S84-SD64-07
71	2	Screw	NAF1029E8-8
72	2	Washer	NAF1058-B-8E
73		Box (Ref.)	S84-SD66-02
74	2	Bolt	S84-07-044-12
75	2	Washer	10750-.064-.328-.750
76	4	Washer	S84-07-017
77		Track (Ref.)	S84-SD31-03
78	1	Fitting	S84-07-514-3
79	1	Eye Bolt	S84-07-524-2
80	2	Bolt	AN4-7
81	2	Washer	AN960-C416
82		Track (Ref.)	S84-SD31-03
83	1	Fitting	S84-07-514-1
84	1	Eyebolt	S84-07-524-1
85	1L	Slat Assembly	S84-07-501
86	1L	Outer Panel Assembly	S84-03-501
87	1	Nut	NAF1137-428T
88	1	Nut	AN310-5
89	4	Nut	AN310-3

NOTES:

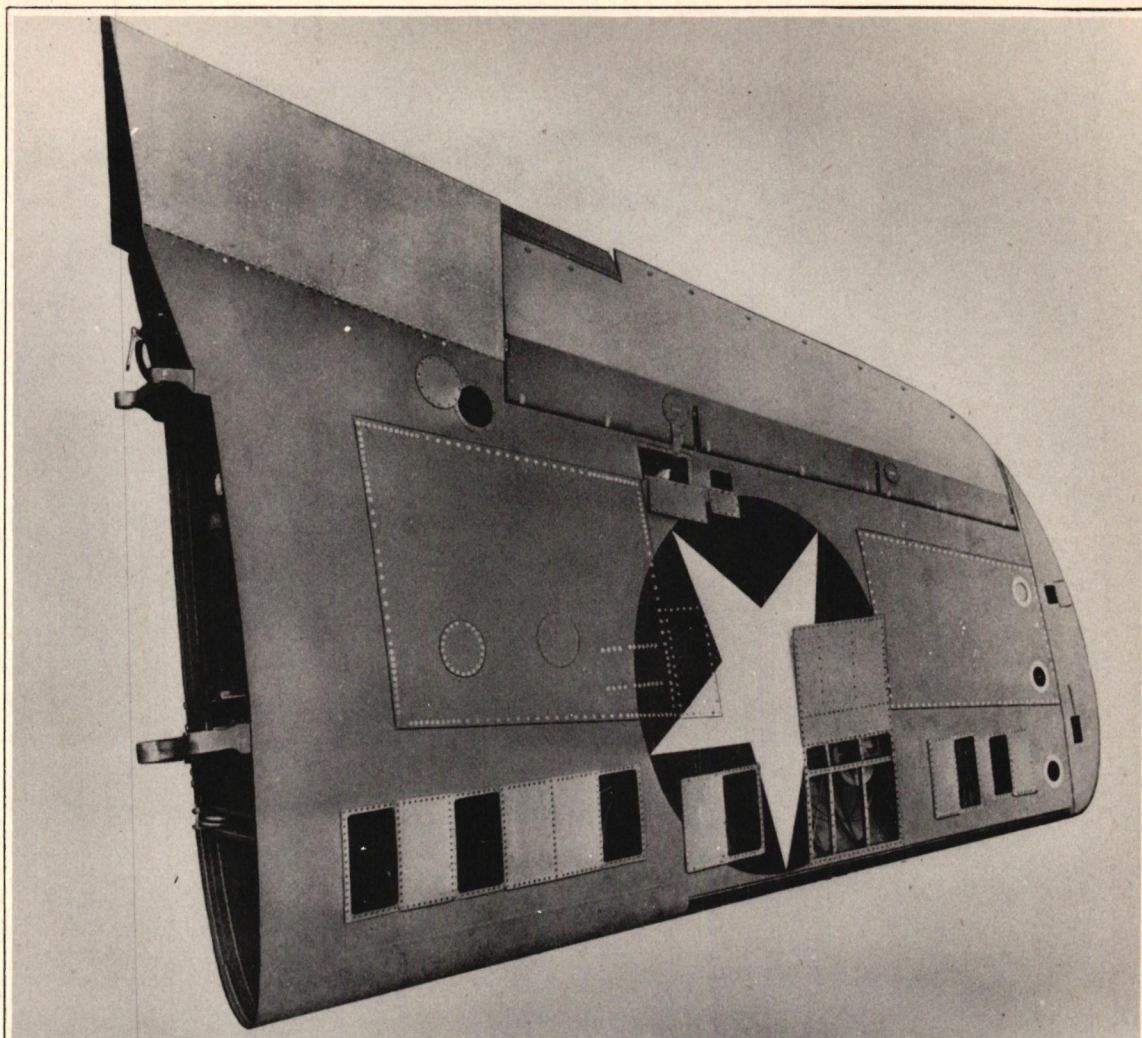
1. Add lock wire as shown.
2. Adjust slat to match wing contour by adding shims 1075-DJ-.032-.0328-.5625.

- (b) Disconnect electric wires.
- (c) Remove 48 screws.
- (d) Remove four bolts and nuts at tip support bracket.
- (e) Remove wing tip.

Reassembly is the reverse of disassembly.

- (2) To remove outer panel proceed as follows:

- (a) Bring hydraulic pressure to zero.



884-8003-04

Figure 12-II - Outer Panel

- (b) Have airplane in three-point attitude.
- (c) Open landing flaps only.
- (d) Disconnect torque tubes of flap operating shafts at wing parting line.
- (e) Remove access openings at parting line.
- (f) Install hoisting sling.
- (g) Remove cotter pins, nuts, and washers on lower attachments only.
- (h) Lift panel barely enough to remove tension from lower bolts.
- (i) Remove bolts.
- (j) Hoist panel to 40-degree angle. (Be sure diving flaps are closed).
- (k) Disconnect chain from sprocket of aileron flexible control. (Have ailerons in line with trailing edge of wing. Stick in "NEUTRAL" position.)

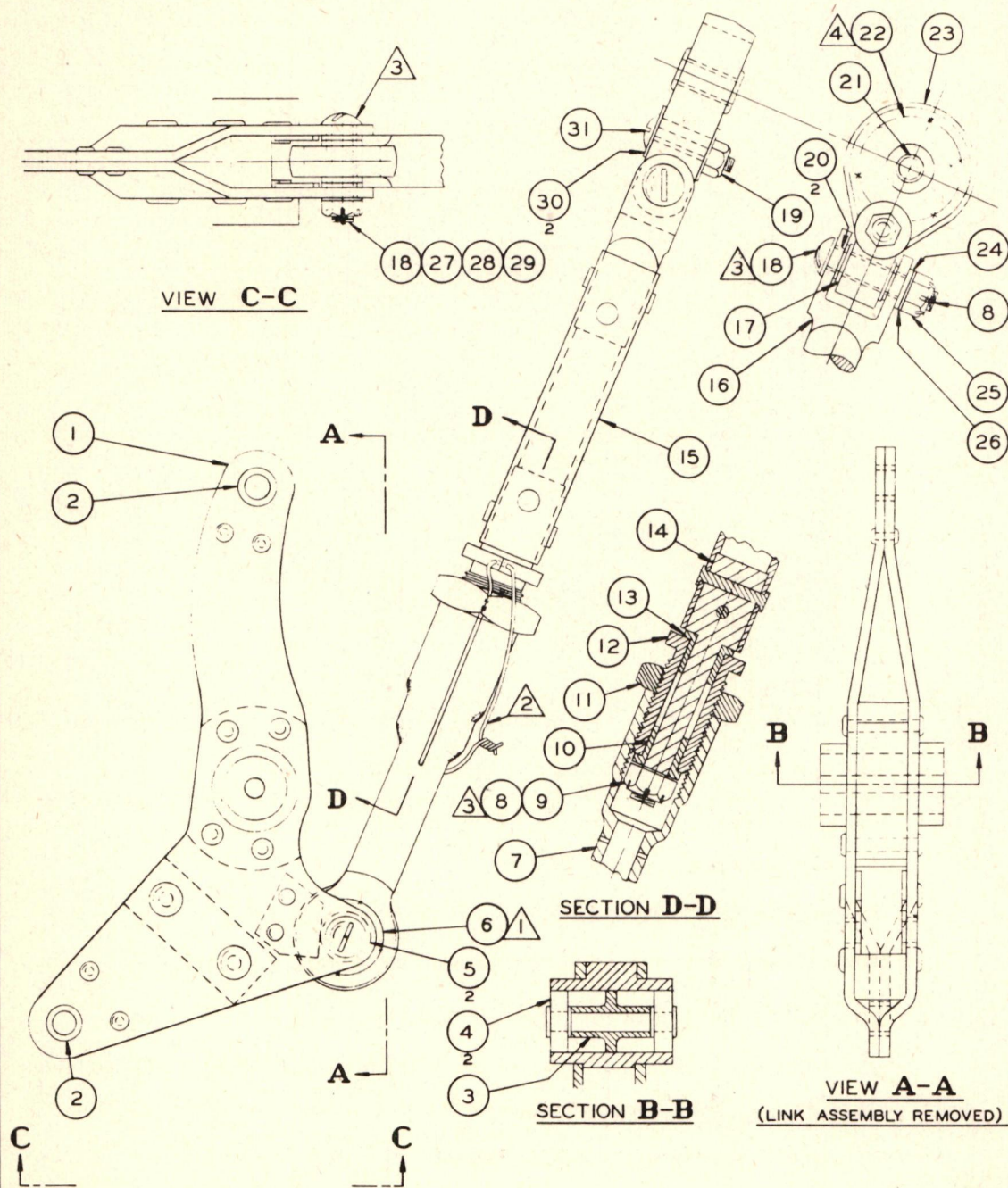


Figure 13-II - Aileron Differential Mechanism

PARTS LIST - AILERON DIFFERENTIAL MECHANISM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L	Bell Crank Assembly	S84-64-863
2	2	Bushing	NAF1066-5-16 *
3	1	Spacer Bearing	S84-64-864 *
4	2	Bearing	AN201-K4A *
5	2	Bushing	NAF-1066F4-12 *
6	1	Bearing	AN200-KS4 **
7	1	Aileron Control Link End	S84-64-891-1 **
8	2	Cotter Pin	AN380-2-3 **
9	1	Nut	AN310-5 **
10	1	Bushing	S84-64-841-1 **
11	1	Nut	S84-64-890 **
12	1	Bushing Housing	S84-64-887-1 **
13	1	Bushing	S84-64-841-2 **
14	1	Fitting	S84-64-888 **
15	1	Tube	S84-64-889 **
16	1	Terminal	S84-64-886-1 **
17	1	Bushing	S84-64-842 **
18	2	Bolt	AN24-22 **
19	1	Nut	AAF365-1032 **
20	2	Bushing	1007-D-4-.125 **
21	1	Spacer	1025-D-.3125-.745 **
22	1	Bearing	AN207 DS **
23	1	Bearing Housing	S84-64-892-1 **
24	1	Washer	AN960-D416 **
25	1	Nut	AN310-4 **
26	1	Washer	AN960-416L **
27	1	Washer	AN960-416 **
28	1	Nut	AN320-4 **
29	1	Cotter Pin	AN380-C2-2 **
30	2	Washer	1075-DD-.064-.203-.625 **
31	1	Bolt	AN526-1032-18 **

NOTES:

* These are a part of CW assembly No. S84-64-863.

** These are parts of CW assembly No. S84-64-893.

① Stake four places each side per Specification No. Z-2012.

② Lock wire as shown.

③ This connection must permit easy rotation after assembly.

④ Stake six places each side per Specification No. Z-2012.

(l) Disconnect pitot lines and wires, slat cables, cannon plug, etc.

(m) Remove upper attachment bolts, carefully guiding panel so that clevis connections do not bind.

(n) Lift outer panel straight up and clear of center panel.
Assembly is the reverse of disassembly.

d. Ailerons. - The ailerons are of metal construction with a metal leading edge and fabric covering on underside. There is a trim tab and a balance tab on the ailerons. The tabs are of metal construction. The balance tab is on the right aileron and the trim tab on the left aileron. The trim tab has a movement of 20 degrees each side of neutral. The ailerons are balanced by steel counterweights in the leading edge and have a 10-degree upward movement and a 15-degree downward movement.

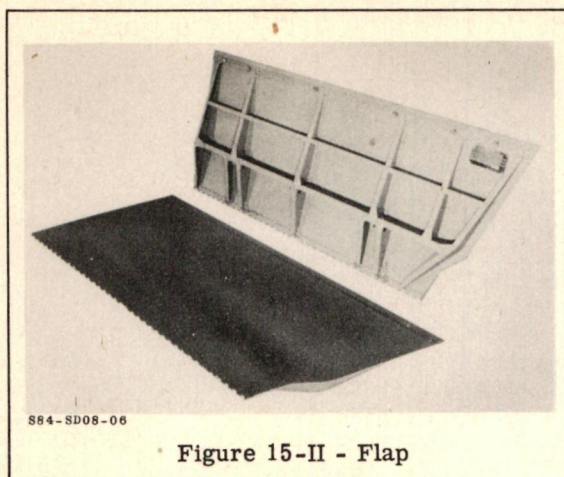


Figure 15-II - Flap

e. Flaps.- The flaps are designed in two sections which operate simultaneously for diving, both flaps opening 25 degrees. For landing and take-off, the lower flap only may be extended a maximum of 55 degrees downward.

The flaps are of all-metal construction. They are of the split-type, the upper and lower surfaces being connected separately by continuous piano hinges to the upper and lower surfaces of the wing. All the skin of the flaps is .025 24 ST anodized aluminum alloy. Rivets used are AN426AD of proper length on the skin and AN 442AD on the interior. The stringers are formed from .025 24SO aluminum alloy, then heat-treated. The main beam of the flaps is constructed of .064 24ST anodized aluminum alloy.

f. Wing Slats.- The wing is equipped with a leading edge slat constructed of aluminum alloy ribs covered with a metal skin. This installation consists of a series of pulleys and cables connected directly to a bracket assembly on the landing gear truss. The mechanism is operated simultaneously with the retraction or extension of the landing gear. All repairs will be made in accordance with the instructions given in section III covering sheet metal and fabric repairs.

The fairing for the wing, landing gear, and empennage are not marked for location on the airplane, but, due to the contour of these sections, it is impossible to assemble them incorrectly. Fasteners used on external surfaces of the fairing are flush with the surface when in the "LOCKED" position.

When replacing fairings, it is advisable to use the same fairings that were originally fitted to the particular airplane.

3. Cabin.

a. The cockpit enclosures consist of sliding plexiglass cabins covering each cockpit. The windshield is one-quarter inch bullet-resistant glass. An operating crank is located on the right side of the fuselage at station 33. Clockwise rotation of this crank causes the forward sliding enclosure to open or move aft over the fixed cabin. In order to open the cabin from the outside, depress the rubber button located on the right side of the airplane at the base of the windshield and manually push the sliding enclosure aft. The sliding enclosure covering the rear cockpit is operated by a crank on the right side of the fuselage at station 135. A counter-clockwise turn of the crank will move the enclosure forward over the fixed cabin.

b. The forward cabin is provided with an emergency release which allows the entire forward cabin to be released at any time, either from within the cockpit or from the outside. To operate the forward cabin emergency release from within, pull the cord located in the top of the cabin just forward of the pilot. This cord is directly connected to the lever which operates the release mechanism. To remove the cabin from the outside, first strike the knob located on the top of the cabin. This forces a handle to raise just aft of the knob; then rotate this handle as far aft as possible and lift the cabin free of the airplane.

c. The rear cabin is also provided with an emergency release of the sliding enclosure. This release allows the top of the cabin to part on the center line and swing outward on hinges. To

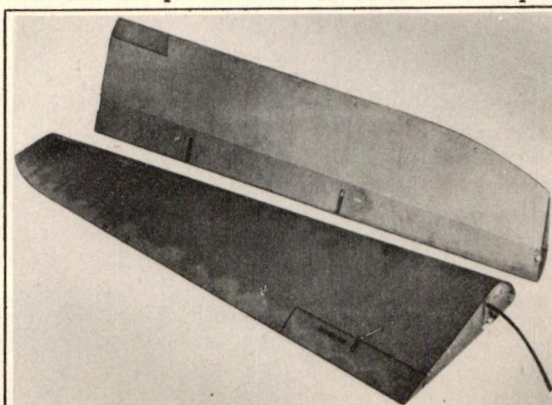


Figure 4-II - Aileron

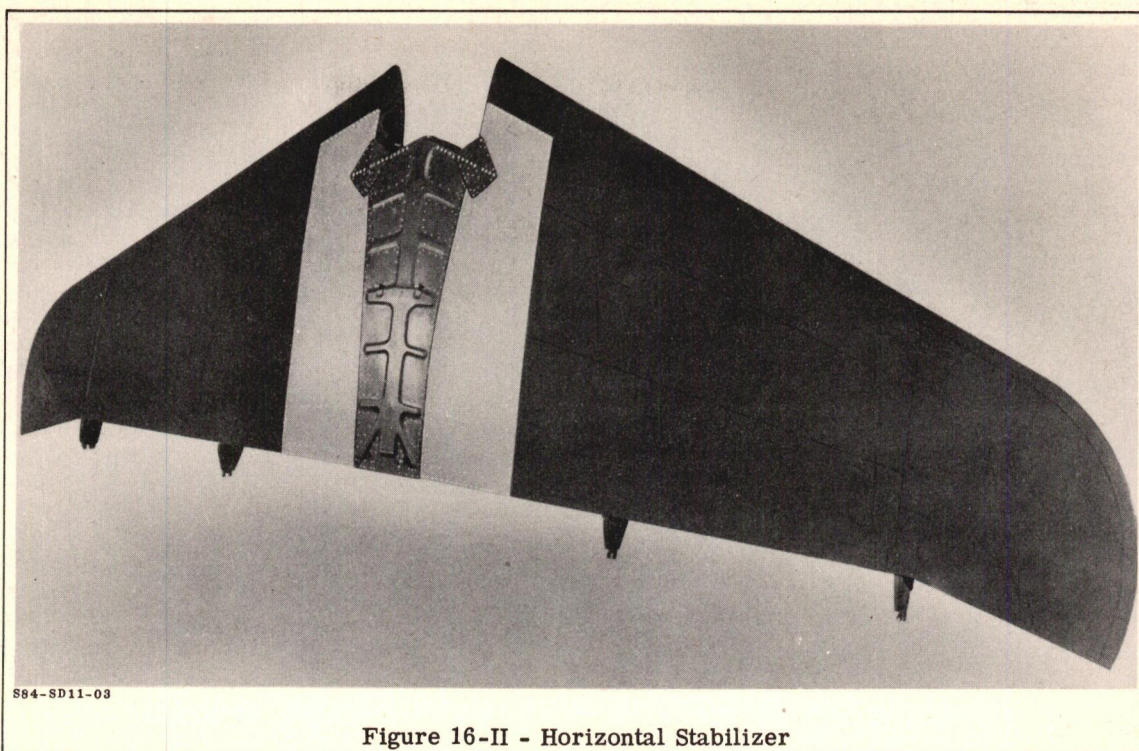


Figure 16-II - Horizontal Stabilizer

operate the emergency release from the inside of the cabin, pull the lever, located approximately eight inches from the forward end of the cabin, as far aft as possible. Push the two sections of the top up and out. To operate the emergency release from the outside, pull the flush lever which is located approximately eleven inches from the forward end of the cabin as far forward as possible.

The latch for manually operating the sliding enclosure is located in the center of the sliding enclosure skirt and is accessible from either the inside or outside. For opening the aft enclosure, a latch is located on the skirt two-thirds of the way forward.

d. The rear and forward cabins are each equipped with an emergency exit door located on the left side of the cabin.

e. Armor plate three-eighths of an inch thick is mounted on the forward upper side of the fire wall. Bullet-resistant glass one and one-half inches thick is mounted just inside the windshield, parallel to the windshield. Armor plating is also mounted on the turn-over structure, gun turret, and flexible gun.

4. Air Controls.

The A-25A, beside having the conventional rudder, elevator, and ailerons, has landing and diving flaps, slats, and tabs.

a. Stabilizer (Horizontal and Vertical).- The horizontal and vertical stabilizers are of very similar construction and will therefore be considered together.

The stabilizers are of the stressed skin, full cantilever type similar to the wings. Stringers are made from extrusion CE-7062, the same bulb angle extrusion which is used in the fuselage. Rivets on the skin are AN426AD-4, while flathead rivets are used on the interior.

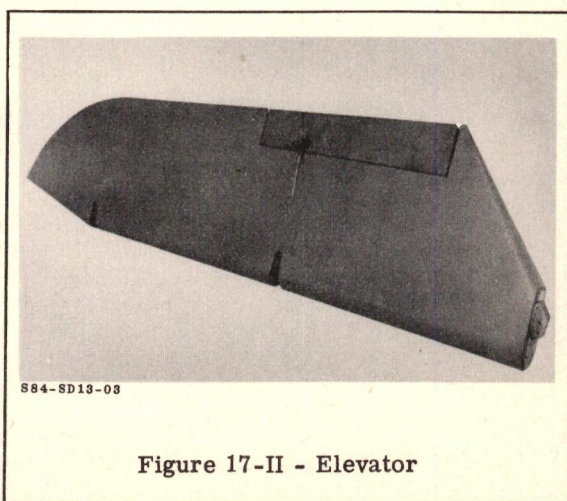


Figure 17-II - Elevator

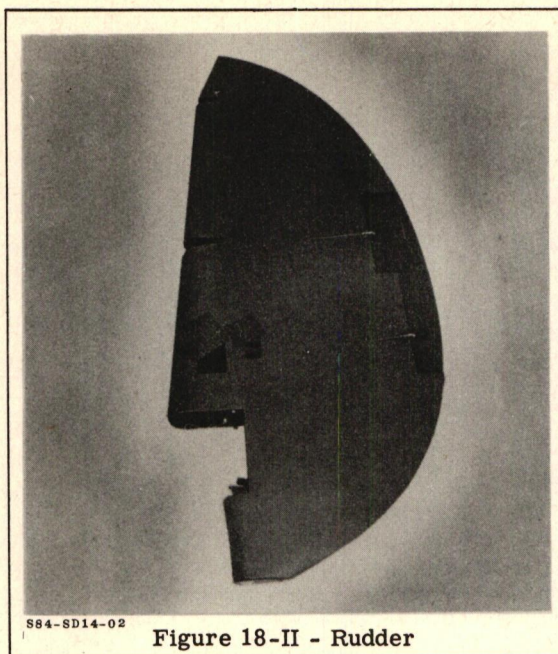
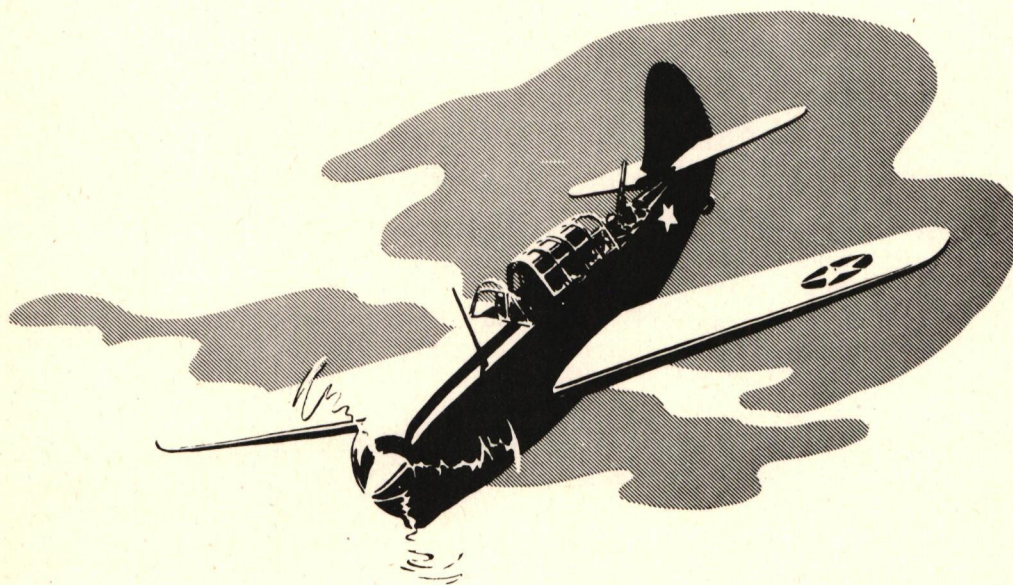


Figure 18-II - Rudder

The horizontal stabilizer tips are attached by 100 degree countersunk machine screws. There are ten stringers and three webs in the horizontal stabilizer.

b. Elevator.- The elevator is fabric covered with a metal leading edge and metal frame. Steel counterweights are placed in the leading edge to obtain static and dynamic balance. There are two hinge points on each elevator. A trim tab is used on the left elevator and a balance tab on the right elevator. The left and right portions of the elevator are rigidly interconnected by a torque tube which transmits the force exerted by the pilot on the control stick to the elevator. Grade "A" cotton fabric is used as a covering and is attached by an aluminum rod in grooved rib cap strips.

c. Rudder.- The construction of the rudder is essentially the same as that of the elevator. It also has a trim and a balance tab. The balance tab is located above the trim tab. The trim and balance tabs are of metal construction.



Section III

STRUCTURAL REPAIR



1. General.

Structural repair means repair to the primary structure, the members which carry the loads. These consist of the spars, ribs, skin, stringers, rings, frames, etc. Small items such as small supports and brackets are secondary and are usually more easily replaced than repaired. No attempt should be made to repair castings; they should be replaced. The general procedure to be followed in structural repair work should be:

- a. Inspection.
- b. Classification of repair.
- c. Selection of materials.
- d. Method of repair.

These steps are inter-related and in some cases overlap. Inspection will indicate the extent of the damage, and during inspection the damage should be classified. The materials which are available will often dictate the method of repair and vice versa.

2. Inspection.

a. Inspection of structural members should be made carefully. Start at the obvious center of the damage and work out. Inspect each member at, or near, the damage, and follow the long members through which the shock of the impact that caused the damage may have traveled. Closely examine these members for deformation; wrinkles; fine hairline cracks; loose, sheared, or cracked rivets; loose, sheared, or cracked bolts and nuts; and elongated bolt and rivet holes. Check the alignment of airfoils and control surfaces. Operate the surface and mechanical controls to determine that they do not bind. Check the bonding jumpers to see that they make pro-

per contact. Very carefully and closely examine castings, forging, welds, and tubular structures such as engine mount, landing gear struts, turn-over brace, etc.

b. A feeler gage can be used in the inspection of rivets. The gage will insure that rivets have not loosened, stretched, or failed, although leaving the heads intact. Particular care should be exercised at all times to insure that no cracks remain undetected in the structure. Fine hairline cracks, if not detected, will open and spread under vibration. Minute cracks caused by bullet impacts should be cut away when cleaning up fractured areas for repair.

c. If the batteries are damaged to the extent that electrolyte leaks into the structure, or if electrolyte or acid is spilled on the structure, employ the following procedure as soon as possible:

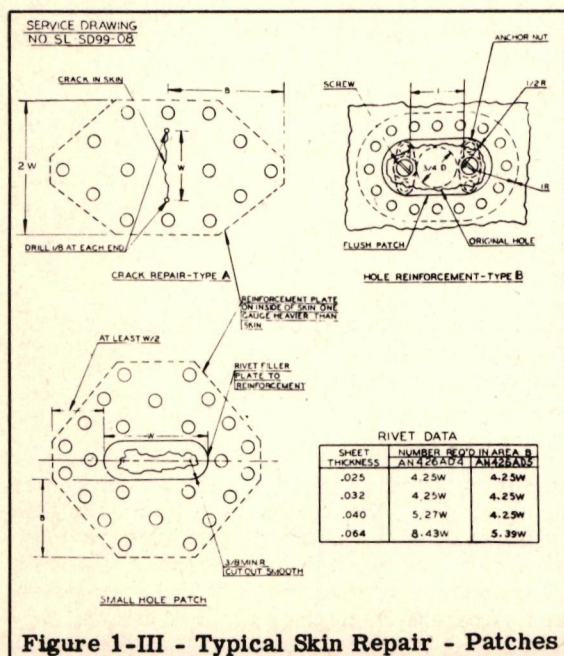
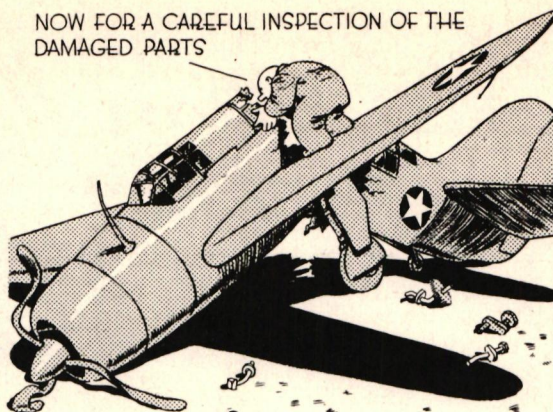
(1) If ammonia (aqua ammonia) is available, apply it freely to all affected parts to neutralize the electrolyte or acid. Following the neutralization, flush affected parts freely with water.

(2) Bicarbonate of soda (baking soda solution) may be used as a neutralizing agent only if ammonia is not available. Be sure that all traces of the soda solution are flushed away with water immediately following the neutralization.

d. Following the flushing, inspect all affected portions of the skin and structure for corrosion. Because of the construction of the Model A-25A Airplane, it is important that any repairs to the skin, stringers, or bulkheads be given careful consideration. Minor repairs, such as dents and small skin holes, may be readily accomplished, but internal structures must be dealt with by splicing and reinforcing the damaged sections before the outer skin is attached. It is important to maintain the original contour and to eliminate excess weight as much as possible.

e. A good procedure to follow for all repairs is: Analyze the extent of the damage to the part before proceeding to repair it; devise several methods for the repair; and proceed with the most convenient and easiest method.

NOW FOR A CAREFUL INSPECTION OF THE DAMAGED PARTS



f. The types of damage have been divided into four major groups to facilitate classification and, consequently, type of repair. The classification and method of repair is as follows:

(1) Negligible Damage.-

(a) Small dents in skin or stringers free from cracks, abrasion, and sharp corners may be neglected provided adjacent rivets and internal structure are intact. In all cases, dents should be bumped out to their original shape whenever possible to prevent their developing into cracks, using care, however, not to stretch or crack the skin during the process. Inspect all rivets near the dent after it has been repaired to see that they were not loosened or sheared.

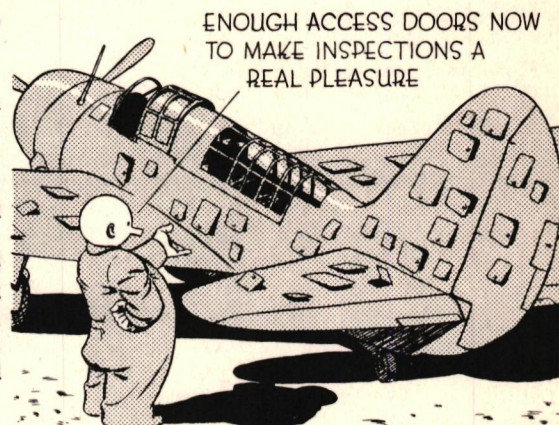
(b) Holes.- Holes and cracks which can be cleaned up to a one-inch diameter or less should be patched by referring to fig. 1-III.

(c) Cracks.- Cracks may be considered as negligible damage when they appear in mem-

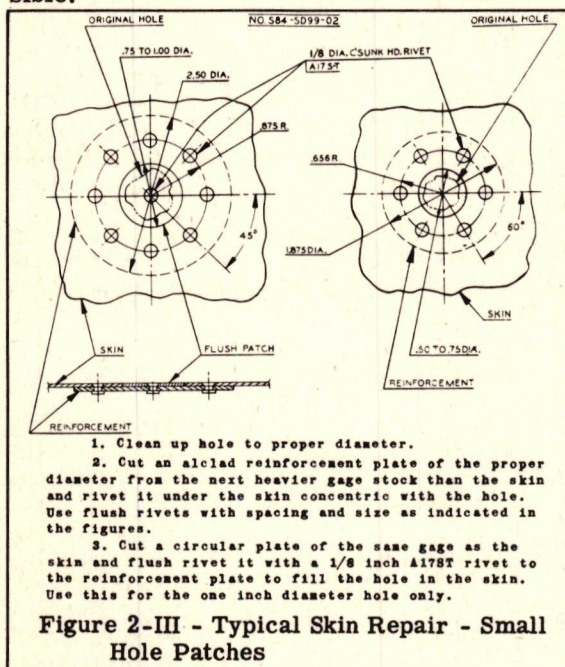
bers which are definitely known to be not highly stressed. However, the crack must have a 1/8-inch diameter hole drilled at each end to reduce stress concentration and be noted so that subsequent checks can be made on its condition.

(2) Damage Repairable by Patching.- Holes and cracks which impair the strength of the structure may be repaired by the use of sheet reinforcements attached by a specified number and arrangement of rivets or bolts. See fig. 5-III. Patches must be shaped and arranged in such a manner as to permit the required rivet or bolt pattern to extend completely around the damage and the edges of the hole in the original stock. Where fittings or other structures are near the damaged area, it is often necessary that the patch extend beyond these in order to obtain the required strength and attachment.

(3) Damage Repairable by Insertion.- In many cases, the damaged material must be replaced to give support to the patch and to other parts of the structure, or to obtain continuity, as in repair of the fuselage skin; this added material is designated as a filler or insert. When damage is extensive, or is in the presence of fittings or other structures which makes it difficult to use patches, the damaged material must be removed and replaced by formed fittings of the same or equivalent material, gage, and shape.



(a) Where practical, the inserts should be made to extend to the edges of the original sheet and should be attached by using the original rivet pattern. In some cases, it may be advantageous to use an access door (fig. 5-III) instead of inserting a patch, especially where it may be necessary to inspect internal structure in the future, which would otherwise be inaccessible.



(b) Skin patches used in conjunction with splicing of stringers must be continuous along the length of the splice and be of sufficient width to take the specified rivet or bolt pattern on each side of the cut.

(c) When effecting an extensive repair to the skin necessitating the insertion of all or a large part of a panel of skin, the damaged portion of the member should be supported so that, when the skin is removed, the adjacent structure will not be overstressed.

(d) Care should be taken in removing rivets not to elongate or damage the rivet holes, keeping in mind that elongated holes must be drilled out to a larger size and a larger rivet installed.

(e) Remove all burrs caused by drilling and rivet the new panel in, using the original rivet pattern. Attach each splice using the same rivet pattern and rivets on each side of the cut as originally used in attaching the nearest parallel edge of the sheet.

(4) Damage Necessitating Replacement.- Damaged fittings, highly stressed material (such as the engine mount or landing gear), or small parts such as clips and reinforcements, which are easier to replace than repair will be replaced. The following is a list of items that will be replaced:

(a) Fittings which are cracked, sprung, or nicked. This is due to the fact that all fittings are either forgings or castings to which the extent of the damage cannot be determined un-

less inspected with special equipment and, since these parts are highly stressed it is necessary that they be replaced.

(b) Other highly stressed parts, such as the engine mount and landing gear. If these parts are nicked, sprung, or cracked, they must be replaced because such damage causes high stress concentration which may lead to more serious major damage, if neglected. Certain parts of the sheet structure are also highly stressed and cannot be successfully repaired. These will be replaced.

(c) Small sheet metal fittings, clips, brackets, etc. may be easily duplicated and should be replaced if damaged or stretched out of shape.

3. Materials and Methods of Repair.

a. Sheet Stock.- All of the material used for outer covering or skin and for various other structural parts is 24ST aluminum alloy sheet. Since most of this sheet is subject to high stress under some flight conditions, high strength alloy 24ST Alclad should be used in all structural repairs where sheet stock is required. Non-structural parts are usually made from some non-heat-treatable alloy such as 2S, 3S, or 52S because it has better forming properties which are essential for many intricately shaped parts.

The gage type of alloy and its condition, respectively, are printed on the sheets when received, such as .020 24ST Alclad, .040 3S Alclad, .032 24ST Al. Al., etc.

Under no condition should a thinner gage material be used to replace a heavier gage material. Always use the next heavier gage when repairing aluminum alloy with Alclad.

(1) Sheet Metal Practice.-

(a) Use a soft pencil for laying out patches, reinforcements, or replacements. A scriber should not be used because it will remove the top layer of pure aluminum, destroying its corrosion resistance, and the aluminum will develop cracks.

(b) When drilling or working on thin, unsupported sheets, back the work up with a wooden block.

(c) When removing or handling aluminum sheets, do not slide them over each other or scratch them in any way, whether painted or not.

(d) Be sure that proper alloy and the proper gage is being used.

(e) Do not clamp aluminum alloy in a vise without aluminum or wooden face pieces that are free from filings and dirt.

(f) Minimum bend radii for sheet metal.

<u>Gage</u>	<u>Radii for 24ST & Alclad</u>		<u>Gage</u>	<u>Radii for 24ST & Alclad</u>
Up to	.015	.094	.040	.125
	.016	.094	.050	.125
	.020	.094	.051	.188
	.025	.125	.063	.188
	.030	.125	.064	.188
	.031	.125	.078	.250
	.032	.125	.081	.310
	.038	.125		

(g) Aluminum alloy should not be bent parallel to the grain but perpendicular to it. The grain runs lengthwise on sheets or parallel to the lettering. If two bends are required on one sheet which are at 90 degrees to each other, make them both at 45 degrees to the grain.

(h) Clamp sheets tightly together before drilling and remove all burs before riveting.

- (i) When forming metal parts, use only rawhide or fibre mallets.
- (j) Drill holes square with the sheet.

(2) **Dissimilar Metals.**- Repairs and replacements will always employ materials identical to those used in the original part and adjacent structure. However, instances may arise in field repair work where, due to a shortage or other cause, a dissimilar metal must be used to make the repair. Wherever feasible, a repair employing a dissimilar metal will be made of a temporary nature and be replaced by a permanent repair fabricated from material similar to that used in the original part, as soon as it is practicable.

Dissimilar metals produce a galvanic action which is a prolific source of corrosion. Corrosion occurs between two dissimilar metals where moisture is present, to act as the electrolyte and conduct current between the two pieces. The material which has the highest electropotential values will be corroded, whereas the material acting as the cathode will remain undamaged. See fig. 3-III.

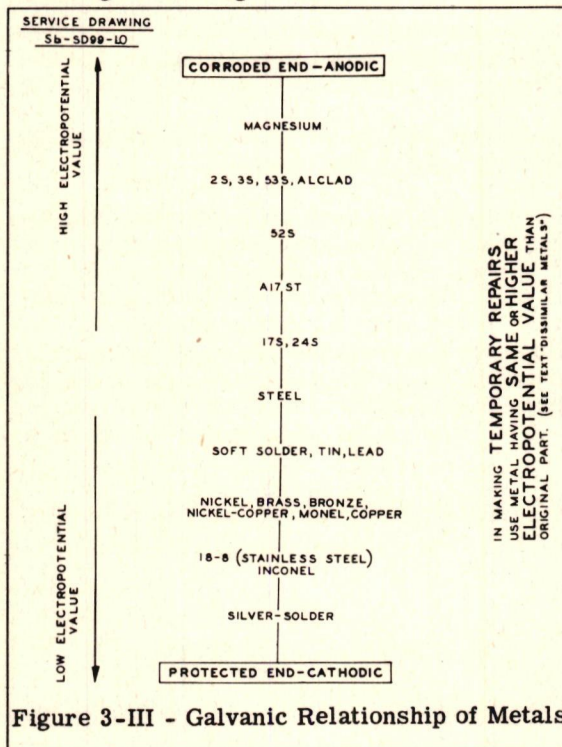


Figure 3-III - Galvanic Relationship of Metals

The purpose of this chart is to enable the mechanic to employ, if possible, in the fabrication of temporary repairs, a metal which has an equal or higher electropotential value than that of the original metal, so that any corrosive action taking place will occur in the temporary repair leaving the permanent parts of the airplane undamaged. The greater the difference in the electropotential values of two metals, the faster the galvanic action and rate of corrosion.

In all instances where dissimilar metals are used, the faying (or contacting) surfaces will each be painted with two coats of zinc chromate primer.

In the case of some repairs, due to their location, size, or other consideration, it may be advisable to provide drainage or weep holes to assist in the evaporation or drainage of moisture.

b. Extrusions.- Extrusions are used as stringers on the Model A-25A Airplane and a method is given for the repair of the most common type in fig. 4-III.

If a portion of a stringer is damaged, a new piece must be inserted and spliced to the original stringer. The insert must be of the same type of extrusion as the original.

Care will be taken when cutting away a damaged portion. The splices cannot interfere with the bulkheads or other structure, but will be as close as possible to the bulkhead for rigidity. Only one splice will be located in each bay of a compression member, and splices in adjacent stringers will be staggered as much as possible. The splice plate can most conveniently be made of a piece of the same extrusion as the stringer and placing it back to back. The splice plate will be tapered in order to eliminate an abrupt change in cross-sectional area and to avoid stress concentration on the end rivets. See fig. 4-III. Larger rivets may be used in order to reduce the length of the splice plate.

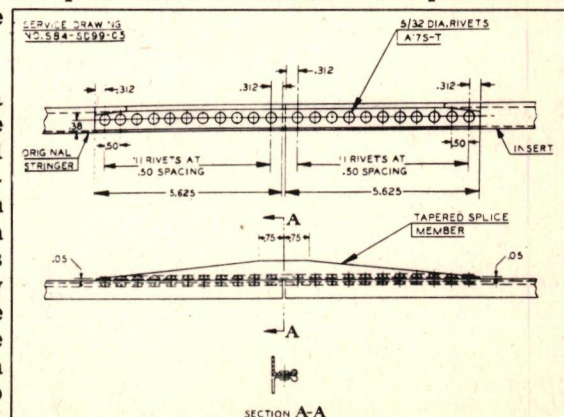


Figure 4-III - Extrusion Splice (CE-7062)

These extrusions are made from 24ST which has an allowable tensile strength of 57,000 pounds per square inch and an allowable bearing of 90,000 pounds per square inch. Since the load must be transmitted from the stringer through the rivets to the splice plate, and then from the splice plate through the rivets to the insert, a number of rivets sufficient to carry this load in shear and bearing must be placed on each side of the splice plate. Usually a factor of safety of about .20 is allowed for the rivets. Only rivets connecting the splice plate to the stringer or insert are counted because of the indeterminate part of the load carried by the rivets into the skin.

Extrusion CE-7062, which is most commonly used in the Model A-25A Airplane, has an area of .081 square inches. The allowable load to be carried by this section would be $.081 \times 57,000 = 4617$ pounds. Using a margin of safety of .20 for the rivets, the load carried by them would be $1.20 \times 4617 = 5540$ pounds.

From table I, the allowable single shear of a 5/32 A17ST rivet is 518 pounds, so that the number of rivets required in shear will be $5540 \div 518$ or 11.

Since this extrusion (24ST) is .040 inch thick, the bearing area per rivet will be the rivet diameter $.156 \times .040 = .00624$ square inches and the allowable bearing per rivet is $.00624 \times 90,000 = 562$ pounds. Therefore, the number of rivets for bearing will be $5540 \div 562 = 10$.

Since shear of the rivets is more critical, eleven rivets will be used on each side of the splice plate. The allowable bearing per rivet on 24ST Alclad is given in table II.

The splice plate must be laid out as follows: Rivets are never placed closer than two diameters from the edge of the sheet or plate, measured from the edge of the sheet to the center of the rivet hole. Therefore, the distance from the edge of the splice plate to the center of the first rivet, in the above case, is $2 \times .156 = .312$ inch. The minimum rivet pitch or distance between rivet centers is 3 rivet diameters, or in the above case, $3 \times .156 = .468$ inches - use .50 inch for convenience. For one-half of the splice plate this would be $.312 + (10 \times .50) + .312 = 5.62$ inches. The second .312 inch is the distance from the last (11th) rivet to the end of the original stringer. The total length of the splice plate will be (minimum) 2×5.62 plus the gap between the original stringer and insert. This splice plate would be arranged as shown on fig. 4-III.

In cases where rivets larger than 5/32 are available, they may be used to reduce the length of the splice plate.

TABLE I

ALLOWABLE SINGLE SHEAR STRENGTH OF A17ST RIVETS

Diameter of Rivet	1/8	5/32	3/16	1/4
Single Shear Strength (pounds)	331	518	745	1325

TABLE II

ALLOWABLE BEARING POUNDS PER RIVET ON 24ST ALCLAD SHEETS

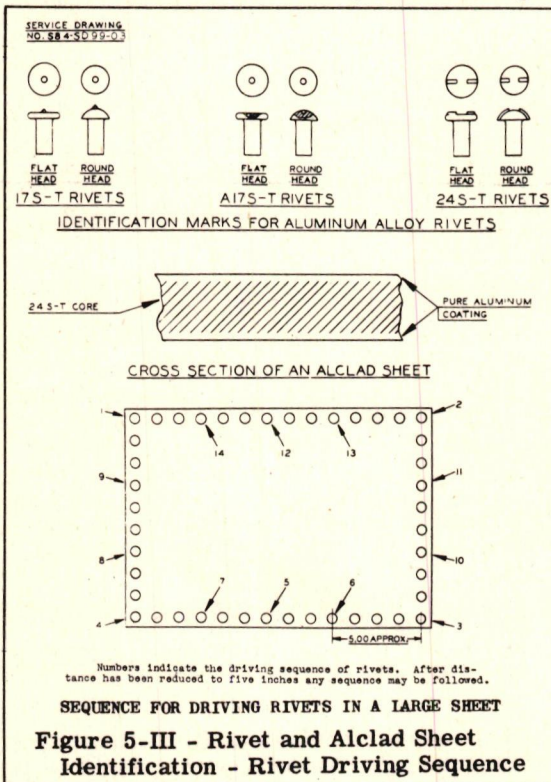
Sheet Thickness	Diameter of Rivet			
	1/8	5/32	3/16	1/4
.025	256	---	---	---
.032	328	409	---	---
.036	369	461	553	---
.040	410	512	615	---
.051	522	653	784	1045
.064	656	819	984	1312
.072	738	922	1107	1476
.091	932	1165	1399	1865

c. Rivets.-

(1) **Rivet Identification.-** The kinds of rivets in general use, listed in the order of their decreasing strength properties, are (fig. 5-III): 24ST, identified by two small raised radial dashes at the ends of a diameter on the periphery of the head; 17ST, identified by a small raised spot or pimple in the center of the head; A17ST, identified by a small depression or dimple at center of head.

Rivets may be replaced by a kind of rivet of higher strength properties but not vice versa.

Unless otherwise specified, all rivets used on repairs shall be of A17ST material because no heat treatment or special handling is required and they may be driven as received.



Since rivet diameters are limited to the two most common sizes, 1/8 and 5/32 inch for field repairs, only these sizes are specified. Rivets of diameters other than those above will not be used for repairs unless competent engineering authority is available. Smaller rivets will not have the required strength and larger diameter rivets will reduce the cross-sectional area of the patch or splice and affect the edge distance and rivet pitch.

In preparing a patch for riveting, it is helpful to first assemble the patch with Cleco buttons. The efficiency of the patch will depend in a large measure on the tightness. Judgment must be used in the number and spacing of the Cleco buttons. This method consists of assembling the patch or reinforcement with proper spacing to insure tightness. Then the remainder of the holes are drilled and the rivets headed. After all of the vacant holes are riveted, the Cleco buttons are removed and replaced with rivets.

Care will be taken when riveting long panels to prevent the metal from creeping and causing wrinkles. In order to eliminate wrinkles and to insure holes lining up, it is important

that the sequence in driving the rivets is staggered. This procedure is illustrated by a diagram on fig. 5-III, in which the holes are numbered in the sequence in which the rivets will be driven. Some other important factors to be remembered while riveting are: Make certain the rivet holes are clean and of the proper size; use the proper length rivet, fig. 10-III.

In the event that some case is not covered by these tables, the following rule will be employed: Add the thicknesses of the sheets through which the rivet is going (grip) to 1-1/2 times the diameter of the rivet. This is the proper length of the rivet. If the proper length rivet is not available, use the next larger size, cut it down to the correct length, and file off the rough edges. Do not leave cracked or marred rivets in a repair. Drill them out and redrive them. See fig. 6-III for common mistakes when riveting. For removing solid rivets, see fig. 8-III.

Care will be taken not to elongate or damage the rivet hole during removal of rivets. However, in all cases where the original hole is damaged or elongated, the next larger size rivet will be used. After removing the rivet, inspect the hole to see that particles of metal are not lodged between the sheets, holding them apart.

When patching a hole, make the patch first, using generous radii. Draw around the patch over the hole which is to be covered, and then cut out the hole. Cutting the hole first is not satisfactory.

(2) Blind Riveting - "Rivnuts".-

(a) General.- The "Rivnut" is a patented fastening device used for blind attachment. It consists of a hollow rivet of 53S-W aluminum alloy, which is threaded on the inside. Installation is accomplished with the aid of a special tool which "heads" the rivet on the "blind" side of the work (fig. 9-III). It may be used as a rivet to join thin sheets of metal or as an anchored nut for the attachment of accessories, brackets, etc.

(b) Types.- "Rivnuts" are manufactured with both flatheads and 115 degree countersunk heads in two types - open and closed end. See fig. 9-III.

(c) Application.- It should be noted (as shown on fig. 9-III) that to use a countersunk "Rivnut" as a rivet, the sheets to be joined must be drilled countersunk. The bearing surface of a press countersunk hole in one sheet of average gage will normally occupy the entire gripping surface of the "Rivnut," limiting its use to that of an anchored nut only.

All "Rivnuts" should be thought of by the mechanic as assemblies. The installation of a "Rivnut" is not complete unless the "Rivnut" is plugged with one of the plugs, fig. 9-III, designed especially for that purpose or with a screw used for attaching purposes, since the full strength of the "Rivnut" is not developed when left hollow.

All cracks located in any part of a bulkhead structure will be drilled at the ends with a 1/8-inch drill to prevent them from spreading. If the crack is less than one inch in length and is not closer than one-half inch from the inside flange, rivet hole, or edge of sheet, it may be neglected after drilling the ends of the crack.

If there is any choice, the bulkhead will not be cut through the stringer cut-out since this is the weakest point. The splice plate will be made of material one gage heavier than the bulkhead. The number of rivets required on each side of a splice plate on a bulkhead is calculated in the same manner as for stringers. As an example, the fourth bulkhead on the A-25A Airplane will be used. Its cross-sectional area will be $.032 \times (.38 + 1.75 + .62) = .088$ square inch. Strength of 24ST alloy is 56,000 pounds per square inch.

The strength of this section will be $.088 \times 56,000 = 4930$ pounds. Using a margin of safety of .20 for the rivets, the strength of the rivets required in shear or bearing would be $1.20 \times 4930 = 5925$ pounds. Using 1/8-inch A17ST rivets from table I, the shear is 331 pounds per rivet. Therefore, $5925 \div 331$ or 18 rivets are required on each side of the splice. For bearing against a .032 sheet, table II gives 328 pounds for a 1/8-inch rivet, or $5925 \div 328$ or 18 rivets are required. In this example, the quantities of rivets required for the bearing and shear loads are identical. When the quantities differ, use the largest quantity. Therefore, in this example, eighteen 1/8-inch rivets on each side of the plate or 36 rivets in all are required. In some cases it may be difficult to form a splice plate to fit to the bulkhead. If this occurs, the splice plate may be made in two pieces. One piece should reinforce the outer flange on the bulkhead nearest the skin and be riveted with the same pattern as the original bulkhead. The other piece should reinforce the web and inside flange of the bulkhead. The inside flange of the splice plate would not have to fit exactly on the inside flange of the bulkhead. If this type of splice is used, the calculated number of rivets must be used in the web alone, using the proper edge distance and distance between rivets, in addition to those required in the length of the splice on the outer flange.

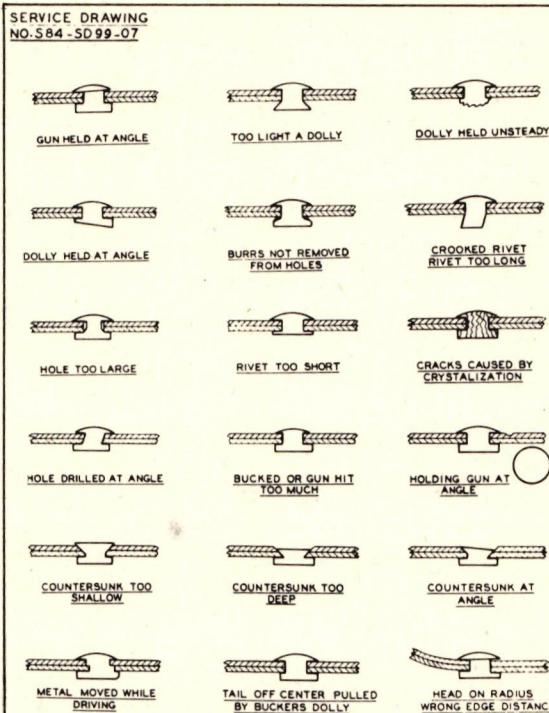


Figure 6-III - Defective Rivet Installation

TABLE 1
CORRECT RIVET LENGTHS FOR RAISED HEAD RIVETS

DIAMETER		3/32	1/8	5/32	3/16
LENGTH** OF RIVET	DASH NO. FOR RIVET	671D-3AD MOD. BRAZIER HEAD AN442AD3 FLAT HEAD	671D-4AD MOD. BRAZIER HEAD AN442AD4 FLAT HEAD	671D-5AD MOD. BRAZIER HEAD AN442AD5 FLAT HEAD	671D-6AD MOD. BRAZIER HEAD AN442AD6 FLAT HEAD
		MAX. GRIP	MAX. GRIP	MAX. GRIP	MAX. GRIP
1/8	- 2	.018	0	0	0
3/16	- 3	.075	.040	0	0
1/4	- 4	.130	.100	.065	.035
5/16	- 5	.190	.155	.125	.090
3/8	- 6	.245	.210	.180	.150
7/16	- 7	.300	.265	.235	.205
1/2	- 8	.355	.325	.290	.260
9/16	- 9	.410	.380	.350	.315
5/8	-10	.470	.435	.405	.370
11/16	-11	.525	.490	.460	.430
3/4	-12	.580	.550	.515	.485
13/16	-13	.640	.605	.570	.540
7/8	-14	.695	.660	.630	.595
15/16	-15	.750	.715	.685	.655
1	-16	.805	.775	.740	.710

TABLE 2
CORRECT RIVET LENGTHS FOR PRESS C'S'K RIVETS*

DIAMETER		3/32	1/8	5/32	3/16
LENGTH* OF RIVET	DASH NO. FOR RIVET	AN426AD3 100° C'S'K	AN426AD4 100° C'S'K	AN426AD5 100° C'S'K	AN426AD6 100° C'S'K
		MAX. GRIP	MAX. GRIP	MAX. GRIP	MAX. GRIP
1/8	- 2	0	0	0	0
3/16	- 3	.039	0	0	0
1/4	- 4	.102	.063	.024	0
5/16	- 5	.164	.125	.086	.047
3/8	- 6	.222	.188	.149	.110
7/16	- 7	.274	.250	.211	.172
1/2	- 8	.322	.313	.274	.235
9/16	- 9	.367	.375	.336	.297
5/8	-10	.412	.433	.399	.360
11/16	-11	.459	.485	.461	.422
3/4	-12	.511	.533	.519	.485
13/16	-13	.573	.575	.571	.547
7/8	-14	.634	.613	.619	.610
15/16	-15	.694	.654	.661	.667
1	-16	.757	.700	.699	.715

Figure 7-III - Rivet Length Charts

When the grip length falls between those given in the tables, select the longer rivet.

For drilling countersunk holes the rivet lengths given in table I shall be used.

*Grip = Total material thickness.

Rivet Length = Grip plus proper amount of material to form head.

**If rivet of proper length not available, cut off longer rivet to exact length, not grip, required.

NOTE: It is very important that, whenever a bolted fitting or part is replaced, all the nuts are safetied with either cotter pins or safety wire so that the nut will not be loosened during flight. It is best to insert a bolt from the top wherever possible so that, in the event the nut does loosen, the bolt will not fall out under ordinary flight conditions.

Bolts will not be used for repair work except in cases of emergency, because they will necessitate continual inspection.

4. Bulkheads.

The bulkheads of the Model A-25A Airplane are identified by station numbers starting from the fire wall. The bulkheads are made in several pieces and spliced together by means of splice plates. The outer flange face of the bulkheads is cut out to provide for the stringers.

In some cases, the damage may require dismantling of surrounding fittings. All damaged fittings, clips, gussets, etc., will be replaced. Bulkhead patches and splice plate will be formed from sheet stock of the same gage and material as the damaged bulkhead. If possible, a damaged splice plate will be used as a pattern and the original splice plate duplicated as nearly as possible. Do not omit flanges when fabricating splice plates.

Small, smooth, isolated dents may be neglected provided that the dents are free from cracks, abrasions, and sharp corners. Ascertain that adjacent rivets are not disturbed. Small holes which do not exceed one-quarter inch in diameter after cleaning up and are at least one-half inch from the nearest hole, edge of sheet, or inside flange, may be neglected except in bulkhead sections which are reinforced.

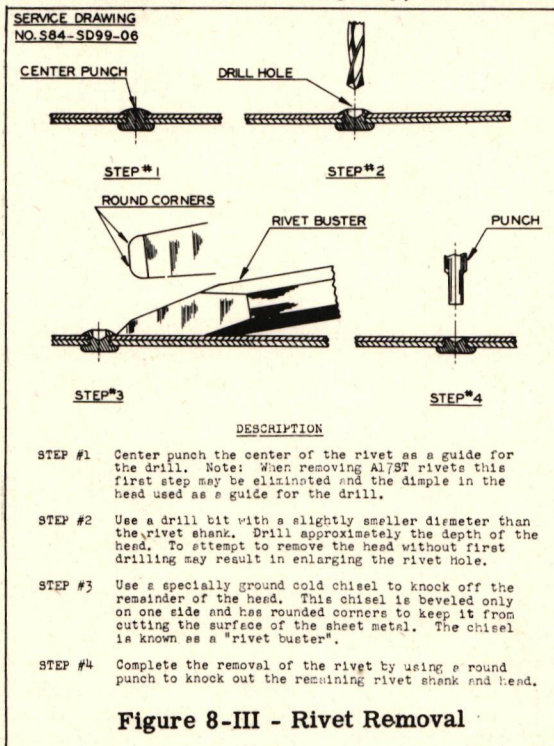
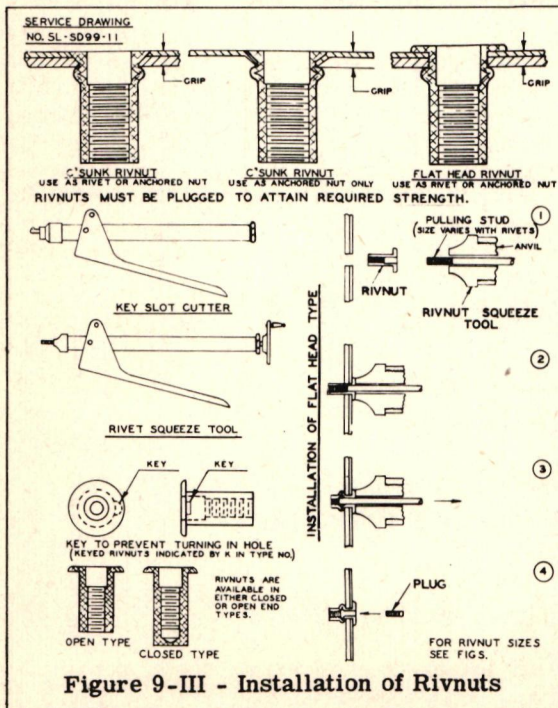


Figure 8-III - Rivet Removal



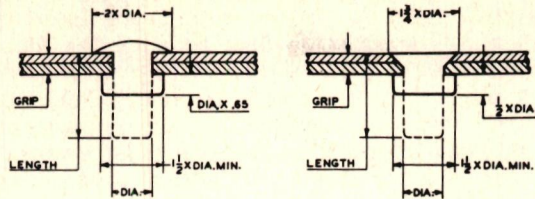
5. Fabric Repairs.

a. General Procedure.- Although the Model A-25A Airplane is principally of stressed skin construction, the elevators, ailerons, and rudder are covered with grade "A" fabric.

Small holes made by stones thrown up by the propeller and wheels may be repaired by cutting a patch large enough to cover the hole with a 1.5-inch margin, fraying the edges back approximately .25 inch (if pinking shears are not available) and dopping over it, using the same finish as the original. Only grade "A" fabric and surface tape will be used in making repairs to the fabric and recovering surfaces. A final inspection of the structure will always be made before the covering is applied. Special note will be made that all parts of the structure coming in contact with the fabric covering are coated with dope-proof paint or a suitable substitute.

Straight, small tears will be repaired by sewing the torn edges together and dopping a piece of pinked edge fabric over the tear, fig. 11-III. In sewing up the tear, the baseball stitch will

SERVICE DRAWING
NO. 584-SD99-08



MODIFIED BRAZIER HEAD
FLAT HEAD RIVET (SIMILAR)

100° COUNTERSUNK HEAD

DRILL SIZES

RIVET SIZE	DRILL NO.	DECIMAL # DRILL SIZE	DECIMAL RIVET SIZE
3/32	40	.098	.0937
1/8	30	.128	.1250
5/32	21	.159	.1562
3/16	11	.191	.1875
7/32	1	.228	.2187
1/4	F	.257	.250

* DRILL SIZES ARE FOR UNDIMPLED HOLES

Figure 10-III - Proper Rivet Installation
and Drill Sizes

be used with the stitches not more than .25 inches apart and extending back into the cover away from the edge of the tear about .25 inch so they will not readily pull out. If the tear is a straight rip, the sewing is started at one end so that, as the seam is made, the edge will be tightly drawn together throughout its entire length.

If the opening is "L" shaped, the sewing will start at the corner so that the edges of the cover will be held in place while the seams are being made. The sewing is done with a curved needle and well-waxed No. eight 4-ply cotton thread. The surface over which the patch is to be applied must be clean and free from dirt or grease. Any dirt, grease, or paint will be removed by rubbing the surface with a rag dipped in thinner and wiping dry with a clean rag, or by scraping the surface with a putty knife after it has been softened with thinner. Care should be taken that the thinner does not drip through on the inside of the opposite surface causing the

dope to blister. A patch of sufficient size is cut from grade "A" airplane cloth to cover the tear and extend at least 1.5 inches beyond the tear in all directions. The edges of the patch will either be pinked similar to surface tape or frayed about .25 inch on all edges.

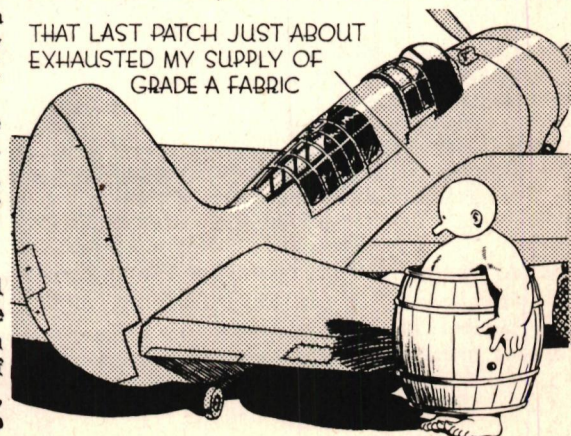
If the damaged portion of the fabric is too badly frayed, a sewed-in patch will be used. The damaged portion of the covering is cut out, making a regular shaped opening either rectangular or triangular. A piece of fabric is cut to extend .5 inch beyond the opening on all sides. The edges of this fabric are turned under .5 inch and sewed to the edges of the opening. The patch will be held in place by a few temporary stitches at the corners while the seams are made. The seams are made in the same manner as for repairing small tears. When the sewing is completed, apply the surface tape, necessary patches, and grommets while brushing on the second coat of dope. Grommets (NAF 213055-3) are used to prevent moisture from collecting in the trailing edge of the lower outside surface of the ribs on the elevator and ailerons. They are placed on the wet dope and then doped over.

When repairs necessitate the replacing of fabric across a rib, fabric will be cut away parallel to the rib on each side between the metal leading edge and beginning of the rib and between the end of the rib and trailing edge in such a manner that a new patch could be sewed in without interfering with the structure. Cut a piece of grade "A" cloth to fit the damaged area leaving a 1.0-inch border in all directions. Center this fabric over the rib so that the overlap is equal on both sides and, using the proper length fabric attaching rod, lock the fabric in place in the rib cap strip. Special care will be exercised so that the slot into which the fabric is to be drawn is not dented or distorted in any manner. As a safeguard against dents and distortion, before attaching the fabric strip to the metal surfaces, a .093-inch diameter, cold, drawn-straight, steel wire will be drawn through the slot. Never under any circumstances pry open the slot and then attempt to close it again.

After the fabric is locked in the rib, cut the patch to a .5-inch border. Tuck under this border and baseball stitch around the entire patch. Apply finishing tape over the stitching and over the rib with the second coat of dope.

When a section requires a patch, removal of the fabric from the fabric slot will be the last operation. The fabric will be cut loose from all of the other panel fastenings and most of the fabric cut away parallel with the fabric slot, leaving a strip of fabric exposed from two to four inches wide. The remaining strip of fabric

THAT LAST PATCH JUST ABOUT
EXHAUSTED MY SUPPLY OF
GRADE A FABRIC



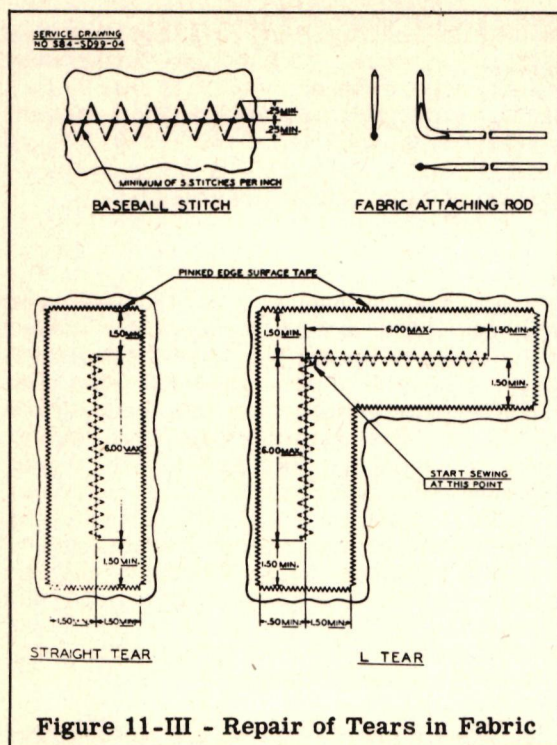


Figure 11-III - Repair of Tears in Fabric

will be worked back and forth in the slot by pulling slightly in the opposite direction to its original position, in order to break loose any tendency for paint or dope to stick the fabric to the metal. When the fabric is well loosened, the fabric and wire will be gripped securely together with pliers and drawn slowly but firmly lengthwise through the slot. In cases where the fabric will not free itself by the above method, dope thinner or any standard dope solvent will be brushed on where the fabric and fabric slot join and, when well-soaked, the fabric and wire will be gripped securely together and slowly but firmly drawn lengthwise through the slot. In both cases, the fabric slot will immediately be cleaned out to remove any substance which might be left in place and interfere when the new fabric is installed.

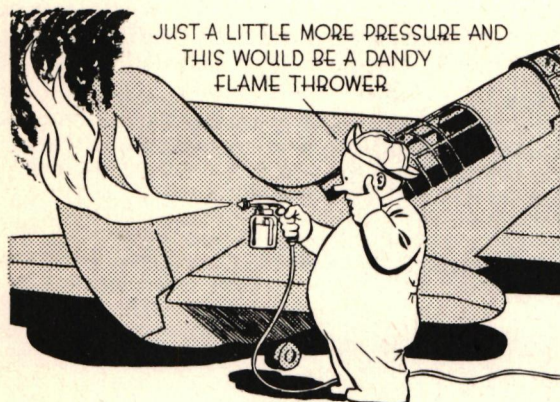
NOTE:

1. Never use copper or steel wire inside the fabric slot. Always use aluminum wire.

2. To prevent binding, the fabric must enter the fabric slot free of wrinkles.

b. Finishing.- The finish used on fabric surfaces on the Model A-25A Airplane consists of four coats of clear cellulose acetate butyrate dope, M-390, followed by two coats of pigmented acetate butyrate dope, M-520.

c. Doping Procedure.- The first two coats of dope will be brushed on. After the second coat of dope has been applied and all tape is in place, allow this coat to dry thirty minutes before lightly sanding with fine sandpaper or trimite. After this, the coats will be sprayed, but alternate coats will be crossed and over-lapped one-half the width of the spray. The proper temperature for doping is about 21.1 degrees C (70 degrees F), but doping may be done up to about 32.2 degrees C (90 degrees F), if the humidity is right. The humidity will never be over 65 percent when doping is attempted. The time between coats should be about 30 minutes under average conditions.



CAUTION: Do not dope or spray near an open flame.

d. Common Troubles.-

(1) Blushing Dope.- This is caused by the moisture in the air precipitating the cotton in the dope. If blushing occurs, spray the finish with clear retarder. This will dissolve the blushed finish and allow dope to dry slowly.

(2) Orange Peel.- The surface becomes pitted like orange peel, caused by holding the gun too far or too close to the work or having too thick a mixture. Pin holes in the finish are

caused by water or oil in the air line; blisters are caused by forced drying, by spraying in the sun, etc; peeling is caused by spraying or brushing over a dirty surface; and runs in the finish are caused by applying too much paint in one spot. This can be remedied by washing with thinner before the paint hardens.



Section IV

SURFACE CONTROLS AND FLAP SYSTEMS

1. Surface Controls.

a. General.- A perspective of the surface controls is shown on fig. 1-IV. The surface control system is of the cable type, with balance tabs provided on the elevators, rudder, and ailerons to reduce the force necessary to move the controls in flight. The balance tabs allow the pilot to move the controls easily while still retaining the proper feel. The operation of the control surfaces is conventional for a single pilot system. All flight controls are operated from the front, or pilot's cockpit.

b. Control Stick.- A detail of the control stick installation is shown on fig. 2-IV. The control stick is of conventional design except that the trigger switches for the wing guns or cannons and bomb release are placed on the stick. The stick assembly pivots longitudinally on three ball bearings located beneath the pilot's floor. A torque tube extends to the right beneath the pilot's floor from the control stick yoke.

The stick pivots laterally about a 5/16-inch bolt which rides in two ball bearings at the top of the yoke. The stick may be removed by disconnecting the gun firing and bomb release wiring, the aileron cables, and the bolt in the top of the yoke.

c. Rudder Control Assembly.- A detail of the rudder control assembly is shown on fig. 1-IV. The rudder control assembly consists essentially of rudder pedal and pedal adjustment mechanism. Brake control linkage is also incorporated with each rudder pedal assembly. Ball bearings are provided at points of rotational movement.

Fore and aft adjustment of the rudder pedal position is provided for by a spring-loaded pin which runs through the rudder pedal tube and is operated by a clip at the inboard side of each pedal. The pin engages a drilled sector.

d. Elevator Control System.- From the elevator arms on the torque tube, two extra flexible cables run aft to an elevator arm assembly at station 255, which in turn operates the elevator push-pull tube. Turnbuckles are provided in both cables near station 195.

e. Aileron Control System.- From the bottom of the control stick, the aileron cable runs to the sides of the fuselage then back to the rear main beam of the center section. The aileron run-around is completed at the center line of the airplane on the bridge frame of the rear main beam. The cables then run out through the wings just aft of the rear beam. Rig with one-eighth inch droop in ailerons; airplane in three-point position, stick neutral.

f. Rudder Control System.- The forward rudder cable runs about pulleys above the pilot's floor near the fire wall and connects at station 120 to lever arrangement. From the levers at station 120, two cables extend aft under the floor to the rudder horn. Turnbuckles are also provided at station 120 for rigging.

g. To adjust rudder throw, proceed as follows:

- (1) Hoist or jack tail to place thrust line horizontal.
- (2) Draw line on floor directly under tail parallel to center line and extending several feet behind airplane.
- (3) Using plumb bob, locate center of hinge. Mark this spot on chalk line at floor.
- (4) Using protractor, mark line at 25 degree tangent on both left and right sides of center line.
- (5) Fasten plumb line on extreme trailing edge of rudder.
- (6) Adjust rudder until plumb bob is directly above 25 degree lines.

h. Trim Tabs.- Trim tabs are provided on the left aileron, left elevator, and the rudder. The control handles are located at the left of the pilot's seat. Sprocket chain drives are used in the control mechanism. Each chain is connected to 3/32-inch cable which runs under the floor and to a similar chain which runs around a gear that operates the respective tab.

S84-SD64-01A

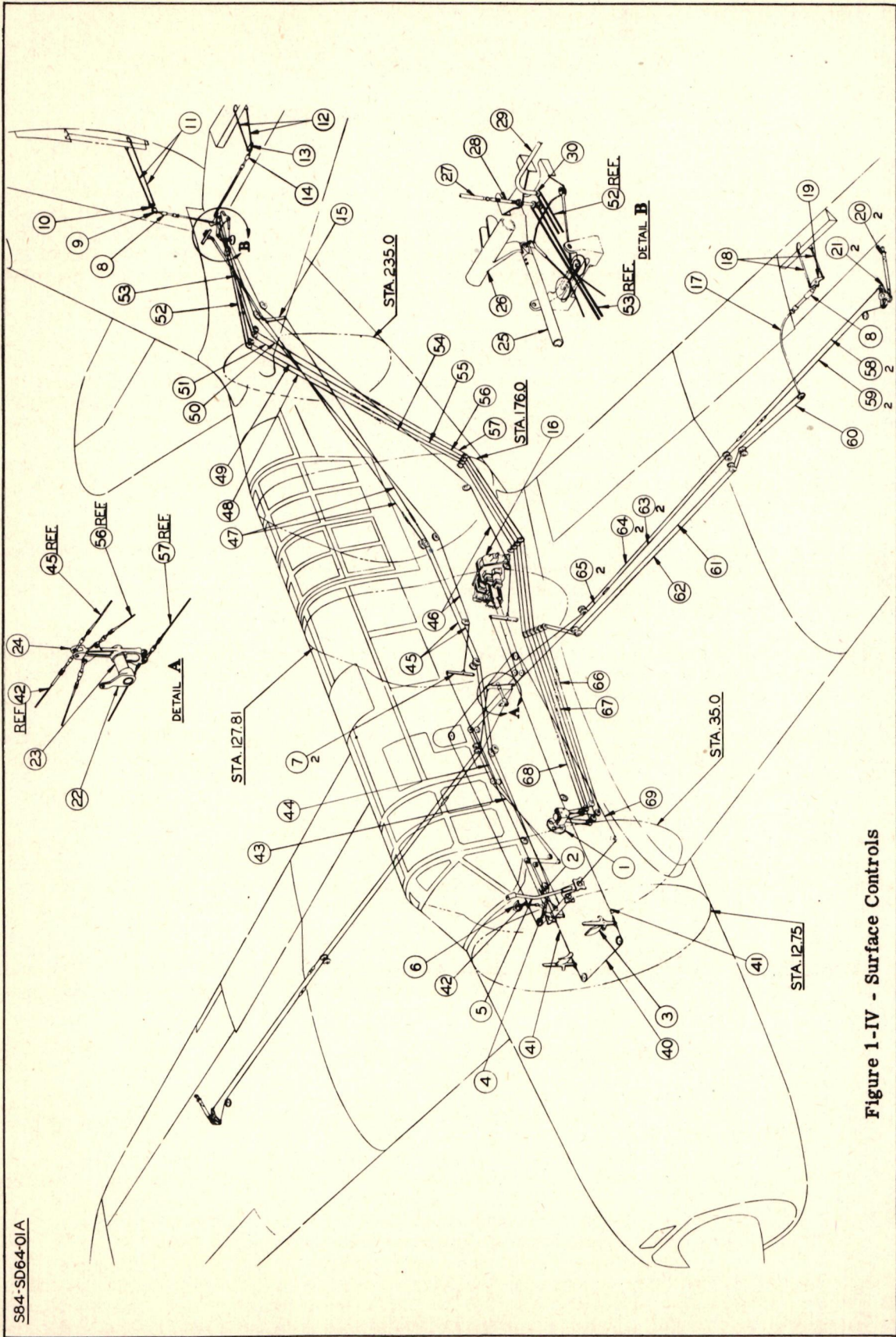


Figure 1-IV - Surface Controls

PARTS LIST - SURFACE CONTROLS

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Trim Tab Control Assembly	S84-61-551
2	1	Landing Flap Indicator Spring	S84-64-638
3		Pedal (Ref.)	S84-SD64-02A
4	1	Dive Flap Spring	S84-64-639
5		Control Stick Assembly (Ref.)	S84-SD64-02A
6	1	Flap Indicator Assembly	S84-64-625
7	2	Arm Assembly	S84-64-528
8	2	Actuator	2835Y (S.S. White Co.)
9	1	Bell Crank Assembly	S84-14-539
10	1	Lever Assembly	S84-14-538
11	2	Rod Assembly	B-6-10-27-2A (Breeze)
12	2	Rod Assembly	B-6-10-1404-2A (Breeze)
13	1	Lever Assembly	S84-13-511
14	1	Actuator	3265Y (S.S. White Co.)
15	1	Arm Assembly	S84-64-524
16	1	Flap Control Box Assembly	S84-33-748
17	1	Shaft Assembly	S84-64-627
18	2	Rod Assembly	B-6-10-1415-2 (Breeze)
19	1	Bell Crank	S84-05-561
20	2	Link Assembly	S84-64-893
21	1L & 1R	Bell Crank Assembly	S84-64-863
22	1	Lever Assembly	S84-64-515*
23	1	Shaft	S84-64-574
24	1	Bell Crank Assembly	S84-64-549
25	1	Elevator Link	S84-64-531
26	1	Elevator Horn Assembly	S84-15-515
27	1	Torque Tube Assembly	S84-14-578 **
28	1	Link Assembly	S84-15-523 **
29	1	Elevator Tab Flexible Shaft	A2765Y (S.S. White Co.)
30	1	Sprocket Assembly	2780Y (S.S. White Co.)
40	1	Rudder Cable Assembly	S84-64-537
41	2	Rudder Cable Assembly	S84-64-538
42	1	Aileron Right Hand Run-Around Cable Assembly	S84-64-544
43	1	Flap Indicator Cable Assembly	S84-64-634-2
44	1	Flap Indicator Cable Assembly	S84-64-634-1
45	2	Elevator Cable Assembly	S84-64-542-1
46	2	Rudder Cable Assembly	S84-64-539
47	2	Elevator Cable Assembly	S84-64-543
48	1	Elevator Trim Tab Cable Assembly	S84-64-568-8
49	1	Elevator Trim Tab Cable Assembly	S84-64-568-16
50	1	Rudder Trim Tab Cable Assembly	S84-64-568-36
51	1	Rudder Trim Tab Cable Assembly	S84-64-568-30
52	1	Elevator Trim Tab Chain Assembly	S84-64-568-19
53	1	Rudder Trim Tab Chain Assembly	S84-64-568-38
54	1	Elevator Trim Tab Cable Assembly	S84-64-568-4
55	1	Elevator Trim Tab Cable Assembly	S84-64-568-12
56	1	Rudder Trim Tab Cable Assembly	S84-64-568-27
57	1	Rudder Trim Tab Cable Assembly	S84-64-568-33
58	2	Aileron Control Cable Assembly	S84-64-594-2
59	2	Aileron Control Cable Assembly	S84-64-594-1
60	1	Aileron Trim Tab Chain Assembly	S84-64-577-11
61	1	Aileron Trim Tab Cable Assembly	S84-64-577-4
62	1	Aileron Trim Tab Cable Assembly	S84-64-577-7
63	2	Aileron Control Cable Assembly	S84-64-575-7
64	2	Aileron Control Cable Assembly	S84-64-575-1
65	2	Aileron Control Cable Assembly	S84-64-575-9
66	1	Aileron Trim Tab Chain Assembly	S84-64-577-14
67	1	Elevator Trim Tab Chain Assembly	S84-64-568-40

PARTS LIST - SURFACE CONTROLS

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
68	1	Rudder Trim Tab Chain Assembly	S84-64-568-21
69	1	Aileron Left Hand Run-Around Cable Assembly	S84-64-539

* This lever used with auto-pilot. It is not used on A-25A Airplane.

** S84-15-523 and S84-14-578 used on airplanes No. 41-18804 and up. Airplane prior to No. 41-18804, use S84-15-521 and S84-14-531 respectively.

i. Balance Tabs. - Balance tabs are provided on the right aileron, right elevator, and the rudder. Operation of these tabs is automatic through linkage attached to the adjacent fixed surfaces. Movement of a control surface displaces the balance tab in the opposite direction, thus lightening the load transmitted by the control surface of the control system.

j. Removal and Installation. - The removal of control cables, control stick, rudder pedals, etc., should be obvious, requiring only normal ability for accomplishment. Control cables should be loosened as required for removal. Before any cables are disconnected, be sure that the affected control surfaces are adequately supported to prevent damage from travel beyond the normal range. (Refer to section II of this Handbook for removal and installation of control surfaces.)

When control surfaces or cables are re-installed, the travel of the various controls must be checked and adjusted if necessary. The full throw angular movement of each control surface is shown on fig. 3-IV. The corresponding movement of the control column is also shown on this drawing.

k. Rigging Loads. - The turnbuckles in the control cables should be adjusted to provide the following cable tensions:

Elevator	300 lb ± 10 lb
Rudder forward of station 121.50 ...	67 lb ± 10 lb
Rudder aft of station 121.50	200 lb ± 10 lb
Aileron	100 lb ± 10 lb
Aileron run-around	50 lb ± 10 lb
Elevator trim tab	25 lb ± 2 lb
Rudder trim tab	25 lb ± 5 lb
Aileron trim tab	25 lb ± 5 lb

l. Minor Repair. - Any repairs to the surface control system which can be safely made will be of a very minor nature. In general, it is recommended that any defective part of the system be replaced. Frayed control cables must be treated as follows:

(1) Aircraft control cables (7 x 19) that are found to be frayed (individual wires broken) will be considered serviceable unless there are more than six broken wires in any one-inch length of the cable. At each 25-hour inspection for frayed control cables, as specified in Technical Order 00-20A, the number of broken wires will be carefully noted, particularly where the cables pass over pulleys or guides. Only those with broken wires in excess of the number specified in any one-inch length need be replaced.

(2) Airplane control cables are regularly oversize and their strength is usually as much as 50 per cent in excess of the design loads to be sustained. Because of the number of wires in 7 x 19 cables (133), their failure is never abrupt but is progressive over periods of extended use. Many of the broken wires that are encountered in use show up soon after placing the cable in service, probably due to some of the wires being under greater tension or else being much harder than the rest. After these over-stressed or over-hard wires have broken, very few additional broken wires will be encountered in normal service for considerable time. The results of recently conducted tests show that the loss in cable strength, due to broken wires, depends upon their concentration at any point rather than on the total number in the cable.

2. Wing Slats.

Wing slats are incorporated between stations 192 and 280 on the leading edge of the outer

S84-SD64-02A

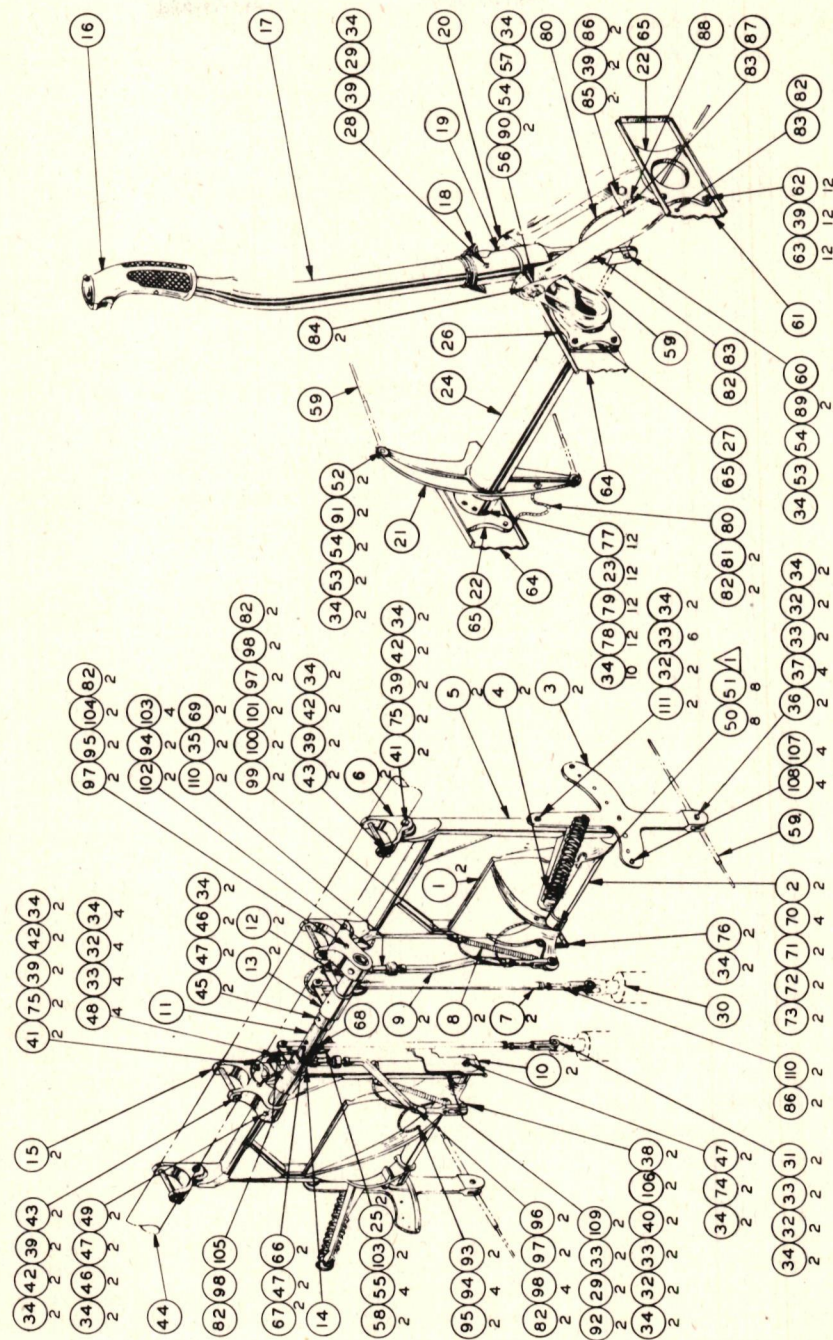


Figure 2-IV - Cockpit Flight Controls

PARTS LIST - COCKPIT FLIGHT CONTROLS

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L & 1R	Pedal	S84-63-532-4
2	2	Tube	S84-63-528
3	1L & 1R	Plate	S84-63-523-1
4	2	Spring	S84-63-526
5	1L & 1R	Pedal (Weld Assembly)	S84-63-512
6	2	Outboard Mount	S84-63-513
7	2	Rod (Weld Assembly)	S84-32-517-1
8	2	Spring	S84-32-520
9	2	Link (Weld Assembly)	S84-32-514-1
10	1L & 1R	Rudder Pedal Adjusting Mechanism	S84-63-535
11	1	Tube	S84-32-516
12	2	Spacer	1029D-.875-.750
13	2	Bell Crank	S84-32-518
14	2	Spacer	S84-32-521
15	2	Inboard Mount	S84-63-514
16	1	Trigger Switch	NAF1173-2
17	1	Stick	S84-62-517
18	1	Boot Assembly	S84-62-524-1
19	1	Control Stick Socket	S84-62-511-1
20	1	Yoke	S84-62-512-1
21	1	Elevator Arm	S84-62-514-1
22	2	Bearing Housing	S84-62-513-1
23	12	Washer	S84-62-531
24	1	Torque Tube	S84-62-520
25	2	Screw	AN515-6-6
26	1	Plate Lock	S84-62-519
27	1	Bearing Housing	S84-62-513-2
28	1	Bolt	AN4-22
29	3	Nut	AN310-4
30		Brake Valves (Ref.)	Vickers AA-13032
31	2	Bolt	AN24-15
32	12	Nut	AN320-4
33	18	Washer	AN960-416
34	43	Cotter Pin	AN380-C2-2
35	2	Screw	S84-32-513
36	2	Bolt	AN24-29
37	4	Washer	1075-DT-.3875-.250-.500
38	2	Bolt	AN24-14
39	23	Washer	AN960D-416
40	2	Tab	1045-D-2
41	4	Bolt	AN4DD-12
42	8	Nut	AN310-D4
43	4	Bolt	AN4DD-24
44		Tube (Ref.)	S84-21-531
45	2	Bolt	AN3DD-12
46	4	Nut	AN310-D-3
47	8	Washer	AN960-D10
48	4	Bolt	AN24-11
49	2	Bolt	AN3DD-13
50	8	Screw	S84-63-527
51	8	Washer	AN935-10
52	2	Bolt	AN25-15
53	3	Nut	AN320-5
54	4	Washer	AN960-516
55	4	Washer	1074-D-6
56	1	Bolt	AN5-34

PARTS LIST - COCKPIT FLIGHT CONTROLS

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
57	1	Nut	AN310-5
58	2	Nut	NAF1137-632
59		Cables (Ref.)	
60	1	Bolt	AN25-20
61		Channel (Ref.)	S84-27-513
62	12	Bolt	AN4-5A
63	12	Nut	NAF1137-428
64		Channel (Ref.)	S84-27-512
65	3	Ball Bearing	FAFNIR K33B
66	2	Screw	1103-DS-12A
67	2	Nut	AAF365-1032
68	1	Fairlead	S84-63-515
69	2	Nut	AN316-4L
70	4	Block	S84-63-530
71	2	Washer	S84-63-531
72	2	Spring	S84-63-533
73	2	Pin	S84-63-534
74	2	Nut	AN310-3
75	4	Bearing	AN200-K4
76	2	Pin	AN392-41
77	12	Bolt	AN23-11
78	12	Nut	AN320-3
79	12	Washer	AN960A-10
80	2	Jumper	NAF1065-F-6
81	2	Screw	AN515-D8-10
82	12	Nut	NAF1137-832
83	3	Screw	AN515-D8-8
84	2	Bearing	AN200-K5
85	2	Bolt	1068-D-SAU-15
86	4	Nut	AN316-4R
87	1	Washer	AN935-8
88	1	Jumper	NAF1065-F-5
89	2	Bushing	1007-D-5-.156
90	2	Bushing	1007-D-5-.125
91	2	Bushing	1001-D-5-.250
92	2	Cotter Pin	AN380-2-2
93	2	Screw	NAF1029E-4-7
94	8	Washer	1074-D-4
95	4	Jumper	NAF1065E-5
96	2	Clamp	1042-DS-8
97	6	Screw	AN515-8-10
98	12	Washer	1074-D-8
99	2	Clamp	S82-31-336-16
100	2	Tab	1045-D-1
101	2	Jumper	NAF1065-F-4
102	2	Screw	NAF1029E-4-6
103	4	Jumper	NAF1065-D-4
104	2	Washer	AN960A-8
105	2	Screw	AN515-8-14
106	2	Bushing	1001-D-4-.203
107	4	Rivet	AN441-6-9
108	4	Spacer	1026-D-.3125-.156
109	2	Eye Bolt	AN43-13
110	4	Clevis	AN486-2
111	2	Bolt	AN24-30

NOTE:



Lock wire required as shown.

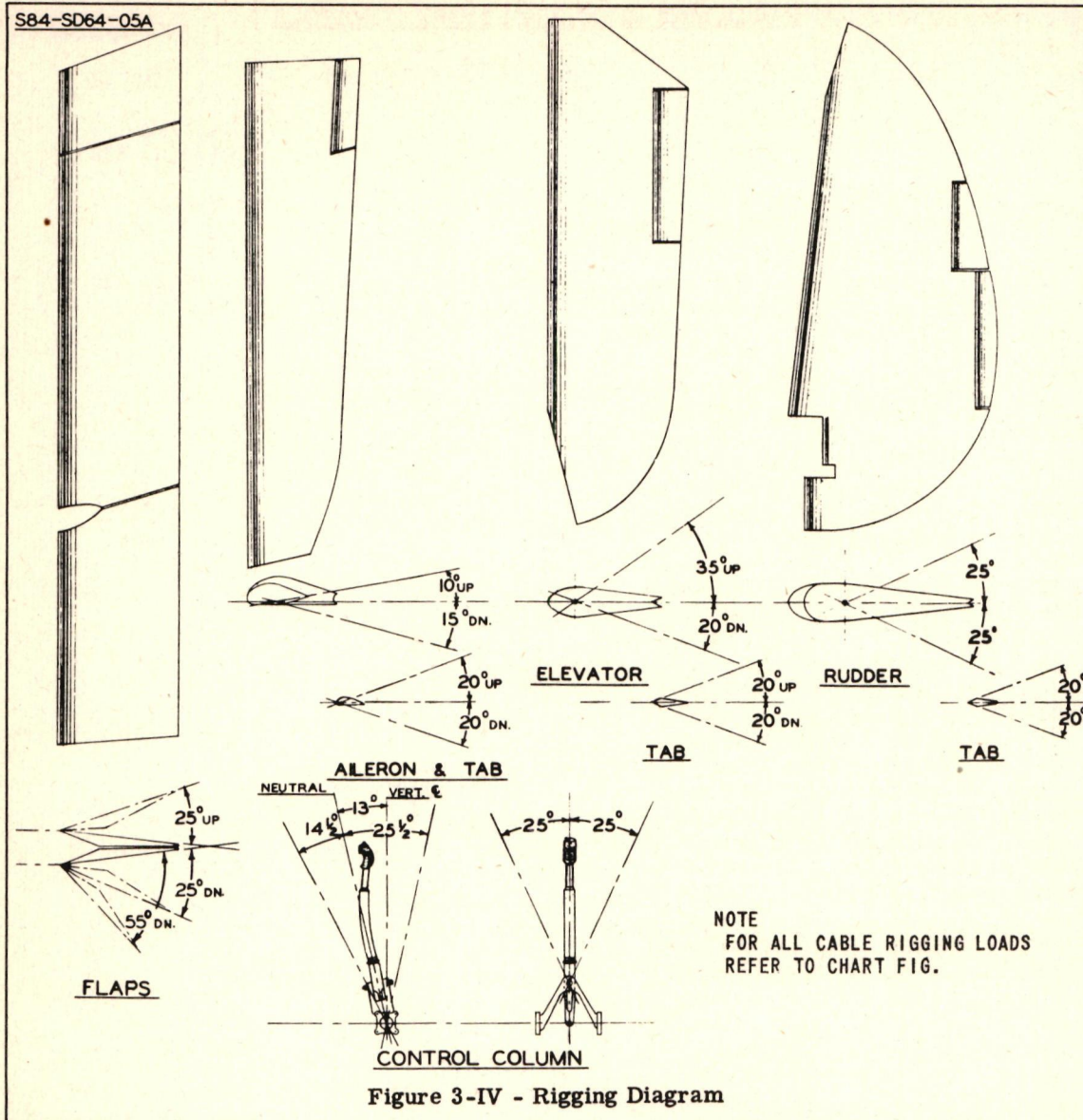


Figure 3-IV - Rigging Diagram

panels. These surfaces operate simultaneously with the landing gear. As the landing gear is extended, the slats open and, as the landing gear retracts, the slats close. A tripod actuating assembly is provided on each landing gear drag truss. Each tripod operates a link which is connected to a trolley that rides on a track forward of the main beam. Cables are attached to this trolley and run around a drum at station 230. Two sets of cables run from this drum and connect to two movable slat tracks at stations 214 and 258. One-quarter inch (7 x 19) cable is used on the landing gear-to-drum assembly. This cable is also provided with two turnbuckles for rigging. The cable around the drum to station 258 is 3/16 inch (7 x 19), while the cable to the track at station 214 is 7/32 inch (7 x 19). Swaged terminals are used on all cables. The slat control system is shown in perspective on fig. 4-IV. Alignment of the slats with the leading edge of the wing is achieved by the two adjusting bolts at each fitting supporting the movable track. The slat should be aligned flush with both the lower and upper surfaces of the wing when the landing gear is locked in the "UP" position. Stops are provided on the aft end of the movable track to limit extension of the slat, in the event the cable control system fails.

3. Flaps.

a. The A-25A Airplane is equipped with landing and diving flaps. The diving flaps split, each flap moving 25 degrees from neutral. For landing, the lower flaps only move down 55 degrees.

Flaps are controlled by a selector valve located in the pilot's cockpit. The principal parts of the hydraulic flap system are as follows:

- Flap selector valve
- Flap position indicator
- Flap control valve
- Flap motors, Vickers No. MF9-713-30-BCF
- Flap control gear box and torque tubes

(1) Flap Selector Valve. - The flap selector valve is located on a bracket at the right side of the pilot's seat. There are four positions on the flap selector; "CLOSED," "NEUTRAL," "SPLIT," and "DOWN."

(2) Flap Position Indicator. - The flap position indicator is located above the floor at the right side of the pilot's seat near the flap selector valve. This mechanism is operated by a cable and pulley arrangement which is connected directly to slide assemblies on the control valve of the center line gear box. Turnbuckles are provided at the control valve to adjust the indicator to "ZERO" when the flaps are closed. This mechanism does not require any special attention, but it should be checked occasionally for proper reading by operating the flaps, and adjusted when necessary.

(3) Flap Control Valve. - The flap control valve for the flap system is located on the flap control box assembly at the center line of the flap beam. This valve controls the flow of hydraulic fluid to the flap motor which operates the flap mechanisms. A detail of this valve is shown on fig. 15-IX. The operation of this mechanism will be given for landing and diving.

b. Landing Flaps. - When the flap selector valve is placed in the landing position, fluid will enter port "B" of the control valve as shown on fig. 8-IX. This will allow fluid under pressure to go through the "bleed" and move the plunger forward, permitting fluid under pressure to pass to the outlet and thence to the hydraulic motor. Referring to fig. 15-IX, the hydraulic motor operates the gear (52) which turns the gear shaft (61). The gear shaft operates a shaft (64) which is geared at one end to the lower flap mechanism. At the opposite end, a threaded shaft (43) is attached on which a slide assembly (20) rides. The slide assembly will move aft while the flap motor is turning the lower flap gear train to the "DOWN" position. Shortly before the lower flaps reach the full "DOWN" position, the slide assembly (20) will contact the aft stop (19). The stop is connected directly to the plunger (41). When the plunger is moved by the stop past the pressure port, fluid will be cut off from the flap motor, thus stopping the motor, with the flaps in the full "DOWN" position (55 degrees).

For retraction of the landing flaps, the selector valve is placed in the "CLOSED" position. Referring to fig. 8-IX, port "A," fluid enters the "bleed" and moves the plunger aft. This will permit fluid under pressure to flow to the outlet and pass to the flap motor. The gears will then turn in the opposite direction and start to retract the flaps. When the flaps have almost returned to their original "UP" position, the slide assembly (20) will contact the forward stop (19) and move it to shut off the pressure to the flap motor when the flaps reach the full "UP" position.

c. Diving Flaps. - When the flap selector valve is placed in the diving position, fluid under pressure is permitted to flow through the selector valves as shown on fig. 8-IX. From these valves, fluid flows to the valves in the control box assembly. Fluid is under pressure to both the upper and lower flap control units. The operation of the lower flaps is the same as during the landing operation for the major portion of their travel. The differences will be noted later. The fluid under pressure enters port "B" of the upper valve, goes through the bleed and moves the plunger forward allowing the fluid to flow from the outlet to the motor. The motor then operates the gears controlling the upper flaps. The gear shaft (65), similar to the gear shaft (64), has a threaded portion (43) on which a sliding assembly (12) rides. This sliding assembly has a rod attached to it which, as it rides back, rotates a cam (24) against the tension of the spring (21). This cam rotates a stop assembly (10) against the tension of spring (11). The stop assembly is contacted by the slide assembly (20) for the lower flaps. The stop assembly then contacts the aft stop (19) connected to the landing flap plunger. This action results in premature stoppage of the landing flap motor and limits the extension of the lower flaps in the diving position to 25 degrees.

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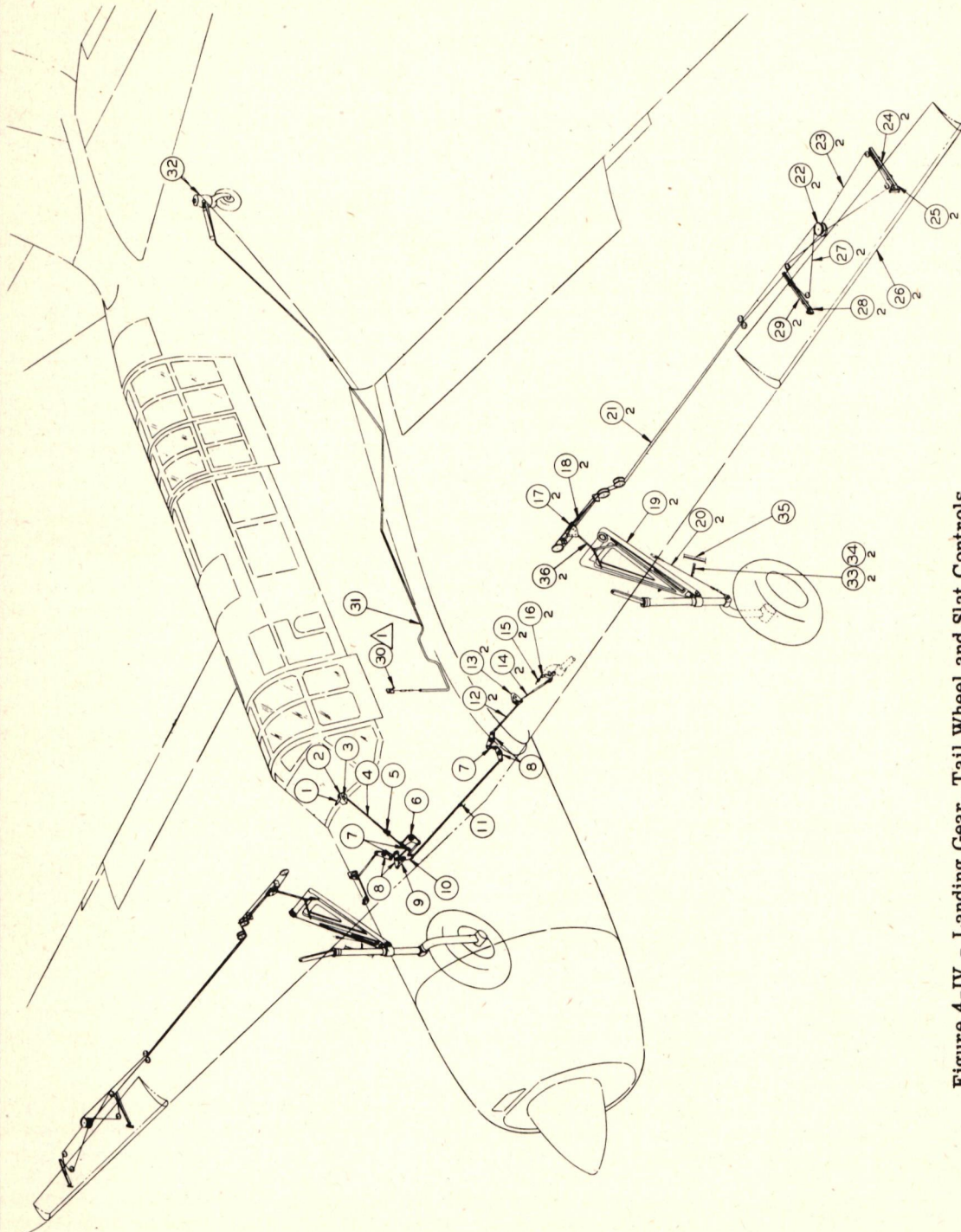


Figure 4-IV - Landing Gear, Tail Wheel and Slat Controls

PARTS LIST - LANDING GEAR, TAIL WHEEL AND SLAT CONTROL

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Handle Assembly	S84-33-514
2	1	Quadrant Cover	S84-33-412
3	1	Lever Assembly	S84-33-030
4	1	Rod Assembly	1078-D-1-B-C4-10.75
5	1	Bellows	82-52-325
6	1	Bell Crank	1057-D-109-2.50-3.00*
7	3	Link	S84-31-573
8	4	Bell Crank	1057-D-52-2.125-2.125*
9	1	Rod Assembly	1077-D-28-3.25
10	1	Bell Crank	1057-D-69-2.50-3.00*
11	1	Rod Assembly	1078-D-1-2B-48.37
12	2	Rod Assembly	1078-D-1-2B-18.25
13	1L & 1R	Bell Crank	S84-31-561
14	2	Rod	S84-31-569
15	2	Spring	S84-31-599
16	1L & 1R	Hook	S84-31-575
17	1L & 1R	Trolley Assembly	S84-07-587
18	2	Track	S84-07-545
19	1L & 1R	Landing Gear Assembly	S84-SD31-02
20	2	Cable Assembly	S84-31-572
21	2	Cable Assembly	S84-07-542
22	1L & 1R	Drum Assembly	S84-07-043
23	2	Cable Assembly	S84-07-540
24	1L & 1R	Track	S84-07-513
25	2	Fitting	S84-07-514-3
26	1L & 1R	Slat Assembly	S84-07-501
27	2	Cable Assembly	S84-07-541
28	2	Fitting	S84-07-514-1
29	1L & 1R	Track	S84-07-512
30	1	Handle	S84-37-057
31	1	Cable Assembly	S84-37-528
32	1	Tail Wheel Installation	S84-SD37-02
33	2	Spring	S84-34-1023
34	2	Clamp	1042-DS-5
35		Landing Gear Fairing Outer Assembly	S84-34-1002 (Ref.)
36	1L & 1R	Tripod Assembly	S84-07-556

* On airplanes, AAF serial Nos. 41-17774 through 41-17799, the following parts were substituted:

6	1	Bell Crank	S84-31-901-951-109-2.50-2.00
8	4	Bell Crank	S84-31-901-951-152-2.125-2.125
10	1	Bell Crank	S84-31-901-951-69-2.50-3.00

NOTES:

1 Cable must be taut.

Pressure to the motor operating the upper flaps is stopped when the slide assembly (12) contacts the stop (9) and moves the plunger (41) to cut off the pressure to the upper flap motor. The upper flaps extend 25 degrees.

d. Closing. - When the selector valve is turned to the "CLOSED" flap position, fluid under pressure enters port "A" on the control valve. Fluid enters bleeds and moves both plungers forward so that fluid is directed to the flap motor. The motors then retract the flaps. The slide assemblies (12) and (20) go back until they contact the stops (13) and (19) and move the valve plungers. This action shuts off fluid under pressure from the motor when the flaps are closed. At this point all of the mechanism is in its retracted position.

e. Adjustment of Flap Control Valves.- Adjustment of the flap control valves should be made according to dimensions shown on fig. 15-IX, and the notes accompanying the drawing. Use the hydraulic hand pump rather than accumulator pressure for operating the flaps while adjustments are being made.

(1) Flap Motor.- The hydraulic motors, Vickers Model MF9-713-30-BCF, employed to operate the flaps are the same as those used to operate the turret and flexible gun. Refer to part 4 of section IX and fig. 16-IX for detailed information on these motors.

(2) Center Line Gear Box.- The operation of the center line gear box should be evident from the description of the operation of the flap control valve. The mechanism is illustrated on fig. 15-IX. It should require little attention except periodic lubrication, as shown on fig. 1-XIX.

(3) Flap Control Gear Box and Flap Operating Shafts.- From the center line gear box, power is transmitted through flap operating shafts to flap control gear boxes located along the span on the rear spar. The upper set of shafts and boxes operate the lower flaps, and the lower set operates the upper flaps.

The shafts with the exception of those in the outer panel are made of .75 inch x .065 inch 4130 chrome-moly tubing. The box assembly contains bevel gears which operate the end connected to the flaps. The gear box screw is threaded with Acme Standard Threads, 8 T.P.I. This allows adjustment of the flap end to within 1/16 inch. Three ball bearings are located in the gear box. The shafts and gear boxes do not need any special attention except periodic lubrication as per drawing No. S84-SD46-02. Their removal, disassembly, or assembly should be apparent. The trailing edges of the flaps should be made to close flush, by adjusting the flap screw end, when the flap motors are in the fully closed position. Care should be exercised when making this adjustment or the flaps may be damaged.

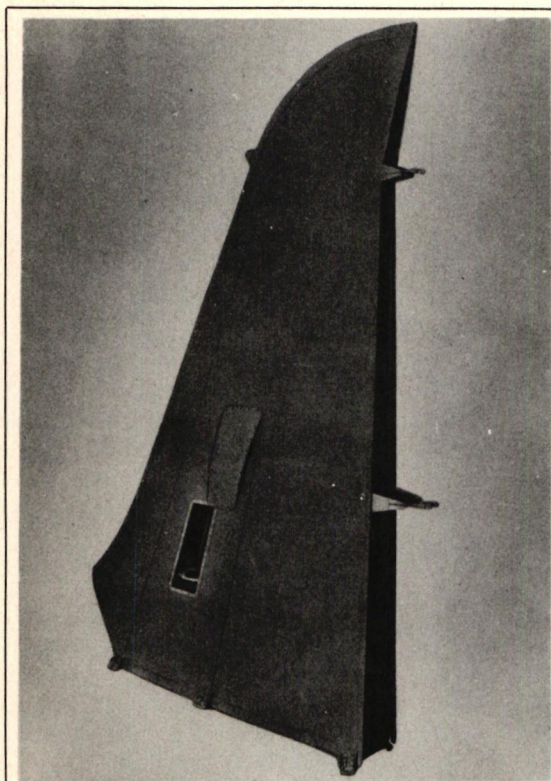


Figure 5-IV - Fin

1. Removal and Installation of Empennage Units.

To remove and install empennage units, refer to fig. 6-IV and proceed as follows for any particular unit:

a. Stabilizer Units.-

(1) Stabilizer and Tip.-

(a) Remove bolts (49), (52), and (53) freeing stabilizer from rear deck.

(2) Tip (63).-

(a) Remove screws (44) (bottom side first).

(b) Remove pins (42) and (43) freeing tip (63) from stabilizer (61).

b. Fin.-

(1) Remove screws (46) freeing fillets (45) (48), (59), (60), and (62).

(2) Disconnect electrical conduit (64) at deck.

(3) Remove cotters (23) and nuts (47) freeing fin from stabilizer.

c. Rudder and Tabs.-

(1) Remove fairings (56), (57), (58), and (54).

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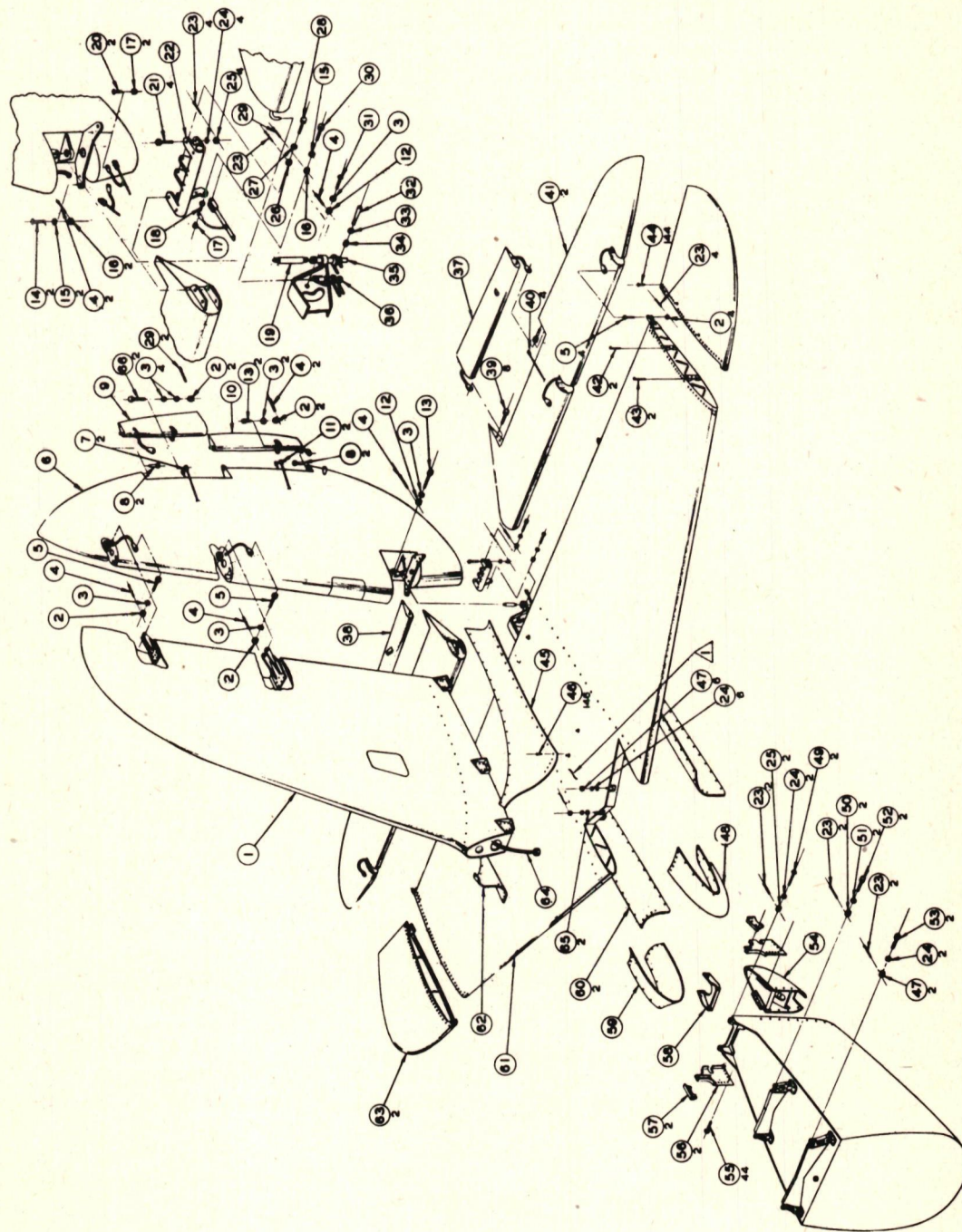


Figure 6-IV - Tail Erection

PARTS LIST - TAIL ERECTION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Fin	S84-12-501
2	10	Nut	AN310-3
3	10	Washer	AN960-D10
4	8	Cotter Pin	AN380-C2-2
5	6	Bolt	AN3-20
6	1	Rudder	S84-14-501
7	2	Control Unit	Breeze Part No. B-6- 10-25.13-2A
8	4	Screw	1101-DS-8
9	1	Balance Tab	S84-14-503
10	1	Trim Tab	S84-14-502
11	2	Control Unit	Breeze Part No. B-6- 10-27-2A
12	2	Nut	AN320-3
13	3	Clevis Bolt	AN23-10
14	2	Clevis Bolt	AN24-12
15	3	Washer	AN960-416
16	3	Nut	AN320-4
17	3	Nut	NAF1137-D-832
18	1	Screw	AN515-D8-16
19	1	Link	S84-15-521
20	2	Screw	AN515-D8-8
21	4	Clevis Bolt	AN26-50
22	1	Control Horn	S84-15-515
23	15	Cotter Pin	AN380-C3-3
24	14	Washer	AN960-D616
25	6	Nut	AN320-6
26	1	Nut	AN320-5
27	1	Washer	AN960-D516
28	1	Clevis Bolt	AN25-30
29	3	Cotter Pin	AN380-C2-3
30	1	Clevis Bolt	AN24-21
31	1	Clevis Bolt	AN23-11
32	1	Pin	663-D-16
33	1	Washer	664-D-6
34	1	Nut	AAF365-632
35	1	Pin	S84-15-520
36	1	Nut	S.S. White Part No. 2765Y
37	1	Trim Tab	S84-13-502-L
38	1	Balance Tab	S84-13-502-R
39	8	Screw (Left and Right Installations)	1101-DS-8
40	4	Control Unit (Left and Right Installations)	Breeze Part No. B-6-10-1404-2A
41	1L & 1R	Elevator	S84-13-501
42	2	Pin (Left and Right Installations)	1093-D-3.6875
43	2	Pin (Left and Right Installations)	1093-D-2.750
44	144	Screw (Left and Right Installations)	1101-D-D-8
45	1	Upper (Left Hand Fillet)	S84-23-502-1
46	146	Screw (All Fillet Installation)	AN526-832-7
47	8	Nut	AN310-6
48	1	Stabilizer Left Hand Nose Fillet	S84-23-502-13
49	2	Clevis Bolt	AN26-25
50	2	Nut	AN310-7
51	2	Washer	AN960-D716
52	2	Bolt	AN7-25
53	2	Bolt	AN6-17
54	1	Tail Cone Fairing	S84-23-540
55	44	Screw (Fairing Installation)	AN526-1032-7

PARTS LIST - TAIL ERECTION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
56	1L & 1R	Lower Rear Fuselage Fairing	S84-23-529
57	1L & 1R	Upper Rear Fuselage Fairing	S84-23-528
58	1	Bracket	S84-11-533
59	1	Stabilizer Right Hand Nose Fillet	S84-23-502-16
60	1L & 1R	Lower Fillet	S84-23-502-9
61	1	Stabilizer	S84-11-501
62	1	Upper Right Hand Fillet	S84-23-502-5
63	1L & 1R	Stabilizer Tip	S84-11-502
64	1	Electrical Connector Plug	AN3106-14S-2P
65	2	Washer	1075-DD-.125-.406-.750
66	2	Bolt	AN23-5

NOTE:

1. Lock wires required as shown.

(2) Disconnect electrical conduit at rear fuselage bulkhead.

(3) Remove bolts (20) to free bonding.

(4) Remove bolts (14) to free rudder control cables.

(5) Remove bolts (13) and (31) to free link (19).

(6) Remove pin (32) to free pin (35).

(7) Remove bolts (5) top bolt last, to free rudder (and bonding) from fin.

d. Rudder Balance Tab. -

(1) Remove bolts at horn to free Breeze control rods (7).

(2) Swing tab to extreme position (either left or right).

(3) Remove bolts (8) to remove bearing installations from rudder. (Remove top bearing last.)

e. Rudder Trim Tab. -

(1) Remove bolts at horn to free Breeze control rods (11).

(2) Swing tab to extreme position (either right or left).

(3) Remove bolts (8) to remove bearing installations from rudder. Remove top bearing last, freeing tab (with bonding) from rudder.

NOTE: Operations (b) or (c) may be performed prior to operation (a), if only tabs are to be removed.

f. Elevator Units. -

(1) Elevator and Tabs. -

(a) Remove nut (36) freeing flexible cable to left elevator.

(b) Remove bolts (21) freeing elevators from control horn (22).

CAUTION: Do not allow elevators to fall to "DOWN" position; lower slowly by hand.

(c) Remove bolts (5) freeing elevator (with bonding) from stabilizer.

(d) Remove bolt (18) to free bond and bolt (30) to free control rod.

(e) Remove bolt (28) to free control horn (22).

(2) Elevator Balance Tab (38).-

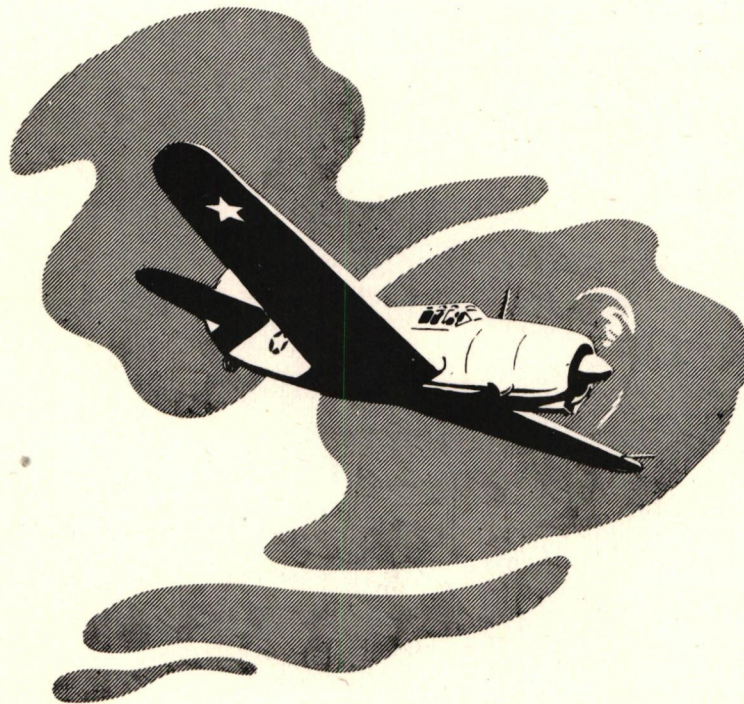
- (a) Remove bolts at horn to free Breeze control rods (40).
- (b) Swing tab to extreme position, either up or down.
- (c) Remove screws (39) to remove bearing installations and free tab (with bonding) from elevator.

(3) Elevator Trim Tab (37).-

- (a) Remove bolts at horn to free Breeze control rods (40).
- (b) Swing tab to extreme position, either up or down.
- (c) Remove screws (39) to remove bearing installations and free tab (with bonding) from elevator.

NOTE: Operations (38) or (37) may be performed prior to operation (2) if only the tabs are to be removed. However, if operation (37) is to precede operation (2), operation (2)a. must be performed.

g. Installation.- To install empennage units, reverse the procedure given above for removal, with the following exceptions: When installing horizontal stabilizer, always install two rear bolts first. Otherwise, bolt holes will not line up. Install elevator balance tab control rod in the second hole out from the tab. Install rudder balance tab control rod in the third hole out from the tab. This is necessary to prevent over-controlling.



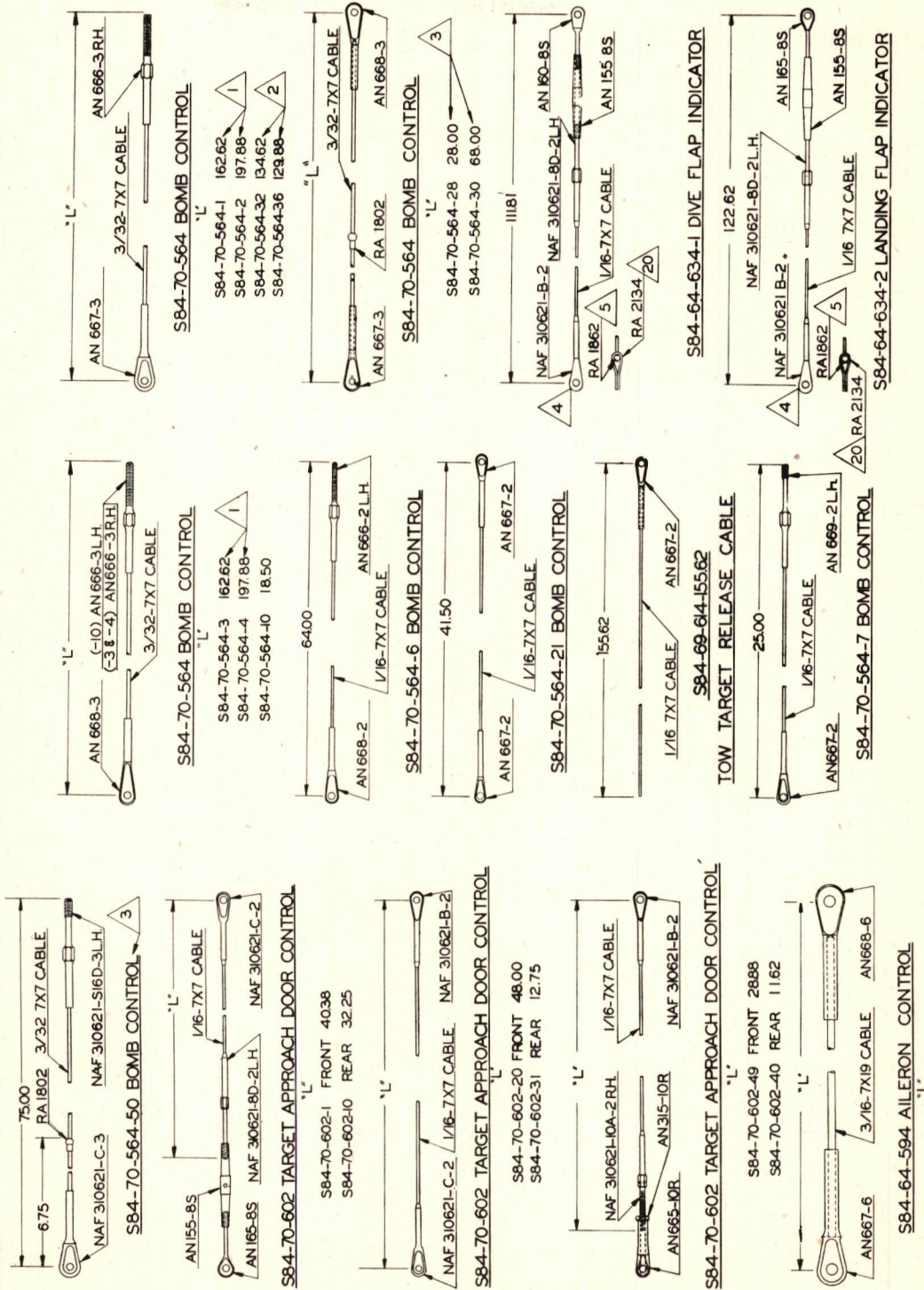


Figure 7-IV - Cable Assemblies



S84-SD64-08

SHEET 3 OF 3 SHEETS

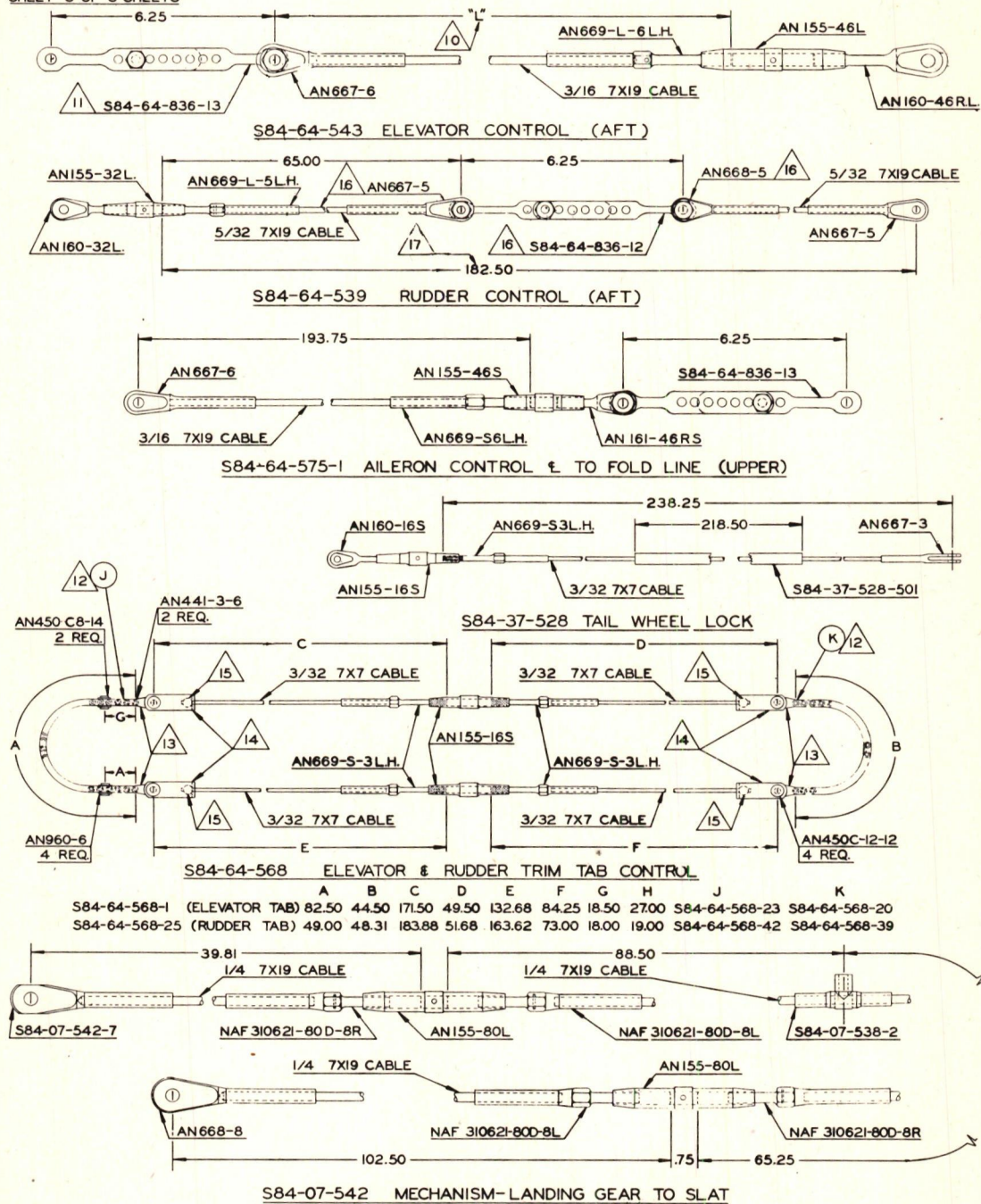


Figure 9-IV - Cable Assemblies

Section V

LANDING GEAR



1. General.

This discussion is limited to the mechanical features and operation of the landing gear and tail wheel gear. The portions of the hydraulic system involved in the operation of the landing gear and tail wheel are discussed in detail in section IX on the Hydraulic System.

2. Main Landing Gear.

a. Description.- The main landing gear consists of similar right and left assemblies and is shown on fig. 1-V.

The principal parts of each assembly are the shock strut assembly and drag truss. The assembly pivots to swing laterally around a longitudinal shaft and when retracted is housed completely within the center panel. A collapsing cable is attached to the center panel structure and the lower portion of the shock strut, in such position that the strut is compressed as the gear is retracted.

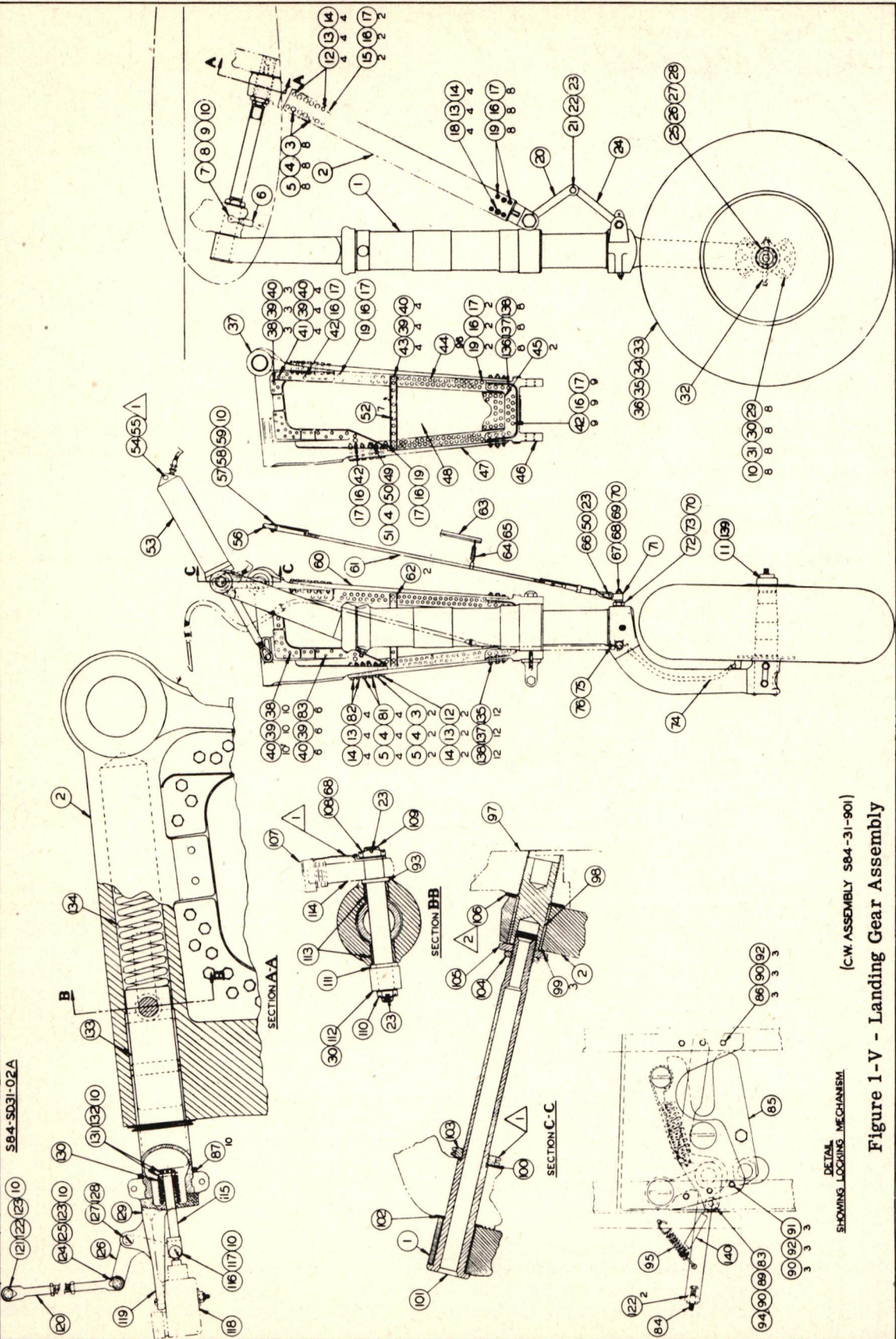
A flag, to indicate the position of each landing gear unit, is located in the top surface of the center panel directly over the "DOWN" latch mechanism.

A micro-switch to operate a warning horn is also incorporated in each "DOWN" latch mechanism. A light is provided inside each center panel for illumination of the flags. The light is controlled by the running light switch.

The drag truss is a "V" shaped frame. The lower end attaches to the lower end of the fixed portion of the shock strut, while the outboard upper end contains the rear pivot bearing. The inboard upper end contains the "DOWN" latch plunger which, in turn, is connected through a cross pin to the piston of the retracting strut. A roller on the aft end of the same cross pin follows an arc-shaped track, to provide proper operation of the plunger as a secondary movement of the strut piston in retracting and extending the landing gear. The latch plunger is spring-loaded and will remain in the locked position, unless overcome by hydraulic pressure operating to retract the strut piston, or when restrained by the relative positions of the roller and track when the gear is not in the full "DOWN" position.

When the gear is in the full "DOWN" position, the plunger extends into a mating hole of the fixed portion of the latch mechanism. The plunger also displaces a spring-loaded rod of the indicator mechanism, which extends the flags and opens the micro-switch of the warning circuit. A projection from the fixed portion of the latch mechanism acts as a positioning stop for the locking plunger as the gear swings down, and thus determines the extended position of the landing gear.

A spring-loaded "UP" latch is located in the forward inboard position of each wheel well. A roller on the cylinder portion of struts engages the "UP" latch hook as the gear reaches the fully retracted position. Cables run from each latch to the selector valve control in the cockpit and are so arranged that movement of the control lever to extend the landing gear first releases the "UP" latches.



(C.W. ASSEMBLY S84-31-901)

Figure 1-V - Landing Gear Assembly

PARTS LIST - LANDING GEAR ASSEMBLY

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L	Shock Strut Assembly	S84-SD31-01
2		Drag Truss Assembly (Ref.)	S84-SD31-04A
3	10	Bolt	AN7-15
4	15	Washer	AN960-D716
5	14	Nut	NAF1137-720
6	1	Turnbuckle Eye (Ref.)	S84-02-982
7	1	Turnbuckle	S84-02-989
8	1	Bolt	AN4-36
9	2	Nut	AN310-4
10	18	Cotter Pin	AN380C2-2
11		Dust Cap (Ref.)	S84-SD31-06
12	6	Bolt	AN6-15
13	14	Washer	AN960-D616
14	14	Nut	NAF1137-624
15	2	Bolt	AN4-14
16	25	Washer	AN960-D416
17	25	Nut	NAF1137-428
18	4	Bolt	AN6-11
19	12	Bolt	AN4-10
20		Link Scissors (Ref.)	S84-SD31-04A
21		Bolt (Ref.)	S84-SD31-04A
22		Nut (Ref.)	S84-SD31-04A
23		Cotter Pin (Ref.)	S84-SD31-04A
24		Link Scissors (Ref.)	S84-SD31-04A
25	1	Washer	AN7503-3
26	1	Nut	AN7502-3
27	1	Collar	34A15-4
28	1	Cotter Pin	AN380C4-14
29	8	Bolt	AN6-13
30	10	Washer	AN960-616
31	9	Nut	AN310-6
32	1	Ring Towing (Ref.)	S84-SD31-01
33	1	Tube	S84-31-901-5 34 x 9 Goodyear Non-Cactus Proof or Equivalent Specification 20-83
34	1	Tire	S84-31-901-6 34 x 9 Goodyear Heavy Duty Non- Skid 10-ply or Equivalent Spec- ification ANC-55
35		Wheel (Ref.)	S84-SD31-06
36		Brake (Ref.)	S84-SD31-06
37	12	Fitting (Upper)	S84-31-592
38	13	Bolt	AN3-7
39	27	Washer	AN960-D10
40	27	Nut	NAF1137-1032
41	5	Bolt	AN3-13
42	11	Bolt	AN4-13
43	6	Bolt	AN3-10
44	96	Rivet	AN442-AD-6-12
45	2	Doubler	S84-31-590-3
46	1	Fitting (Lower)	S84-31-589
47	1	Cap Strip (Inboard)	S84-31-587
48	1	Web	S84-31-590-2
49	1	Bolt	AN27-20

PARTS LIST - LANDING GEAR ASSEMBLY

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
50		Nut (Ref.)	S84-SD31-04A
51	1	Cotter Pin	AN380C4-4
52	7	Rivet	AN442AD5-9
53	1	Retracting Strut (Ref.)	S84-SD33-07
54	1	Bolt (Ref.)	AN77-21
55	1	Washer (Ref.)	AN960-A716
56	1	Terminal (Up)	S84-31-549
57	1	Bolt	AN25-31
58	1	Washer	AN320-5
60	1	Cap Strip (Outboard)	S84-31-586
61	1	Cable Assembly	S84-31-572
62	2	Channel	S84-31-593
63	1	Fairing (Ref.)	S84-34-1002
64	1	Spring	S84-34-1023
65		Clamp	1042-DS-5
66		Bolt (Ref.)	S84-SD31-04A
67		Bolt (Ref.)	S84-SD31-04A
68		Nut (Ref.)	S84-SD31-04A
69		Washer (Ref.)	S84-SD31-04A
70		Cotter Pin (Ref.)	S84-SD31-04A
71		Nut (Ref.)	S84-SD31-04A
72		Nut (Ref.)	S84-SD31-04A
73		Nut (Ref.)	S84-SD31-04A
74	1L	Brake Installation (Hydraulic)	S84-32-501
75	1L	Bracket (Hydraulic Support)	S84-33-893
76	1	Washer	AN960-A106
81	4	Bolt	AN7-16
82	4	Bolt	AN6-17
83	7	Bolt	AN3-12
84	1	Bolt	AN3-6
85	1	Up Lock Assembly	S84-31-632
86	3	Bolt	AN3-4
87	10	Shim	1075-DD-.012-1.656- 1.875
88	3	Washer	AN960-10
89	1	Nut	AN310-3
90	7	Washer	AN960-10
91	3	Bolt	AN23-8A
92	6	Nut	AAF365-1032
93	1	Washer	1075-DD-.077-.638- 1.000
94	1	Cotter Pin	AN380-C2-2
95	1	Spring	S82-69-402
96	1	Bracket Installation Support (Ref.)	S84-31-547
97	1	Landing Gear Wing Truss Assembly (Ref.)	S84-31-555
98	1	Pin (Drag Truss) (Ref.)	S84-31-552
99	3	Shim	1075-DB-.010-2.010- 2.750
100	1	Washer	S84-31-581-2
101	1	Pin (Landing Gear Hinge)	S84-31-526
102	1	Washer	S84-31-581-1
103	1	Nut	S84-31-532
104	1	Nut	S84-31-534
105	1	Nut (Drag Truss)	S84-31-523
106	2	Shim	S84-31-615
107	1	Nut (Piston End Landing Gear Retracting) (Ref.)	S84-33-605

PARTS LIST - LANDING GEAR ASSEMBLY

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
108	1	Washer	S84-31-598
109	1	Shaft	S84-31-570
110	1	Nut	AN320-6
111	1	Washer	1075-DD-.063-.513-.875
112	1	Needle Bearing	RBS#713 Roller Bearing Co. of America
113	2	Spacer	S84-31-608
114	1	End Assembly (Piston Landing Gear) (Ref.)	S84-33-604
115	1	Pin	S84-31-562
116	1	Bolt	AN23-11
117	1	Nut	AN320-3
118	1	Housing Contractor (Ref.)	S84-66-720
119	1	Locking Indicator Assembly	S84-31-901-1
120	1	Rod	AN703-1225
121	1	Terminal	AN665-21R
122	3	Nut	AN315-3R
123	2	Pin	AN393-11
124	1	Terminal	AN665-21L
125	1	Nut	AN315-3L
126	1	Bell Crank	S84-31-567
127	1	Bolt	AN23-15
128	1	Nut	NAF-1137-1032T
129	1L	Bracket	S84-31-566-1L
130	1	Spring	S84-31-568
131	1	Washer	S84-31-596
132	1	Nut	AN320-4
133	1	Lock Pin	S84-31-522
134	1	Spring	S84-31-515
135	12	Bolt	AN5-10
136	8	Bolt	AN5-13
137	20	Washer	AN960-D516
138	20	Nut	NAF1137-524
139		Lock Wire (Ref.)	S84-SD31-07
140		Rod Assembly (Ref.)	S84-31-569

NOTES:



1 Lock wires required as shown.



2 Use shims as required. Do not use more than 3 shims in combination of thickness per drag truss.



3 Landing gear must operate freely after shimming when jam bolt is locked securely against pin.

4. To adjust Goodyear brake, screw disc retaining and adjustment nut up tight and then back off until .049 clearance is obtained by means of a feeler gage. (Clearance is given for entire set on each wheel and not for each disc.)

5. Landing gear must operate at all speeds up to 140 mph.

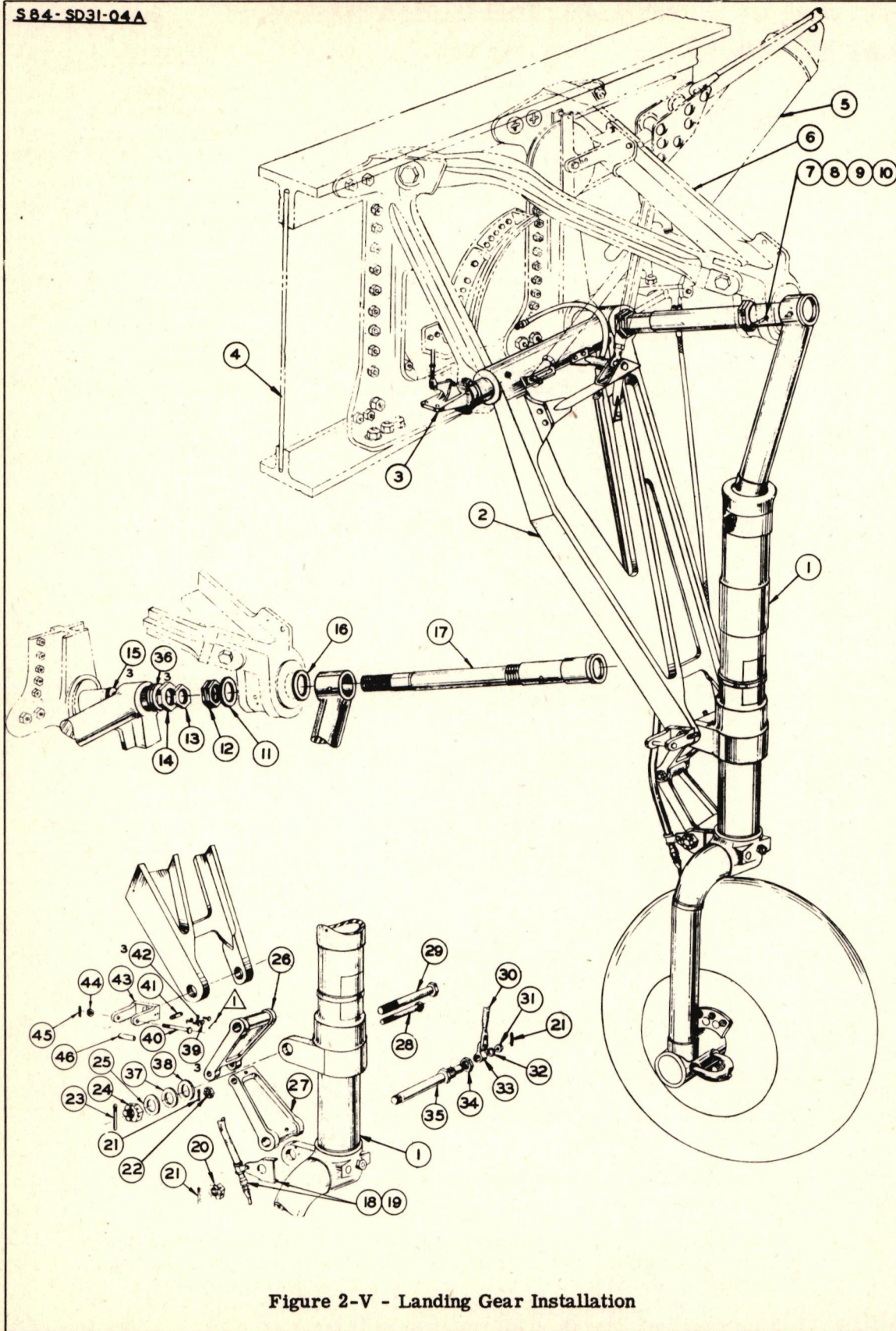


Figure 2-V - Landing Gear Installation

PARTS LIST - LANDING GEAR INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L	Oleo Assembly	S84-SD31-01
2	1L	Drag Truss Assembly	S84-SD31-02
3	1	Locking Indicator Assembly	S84-SD31-02
4	1	Main Beam Assembly	S84-04-504 (Ref.)
5	1	Strut and Fitting Assembly	S84-33-989 (Ref.)
6	1	Landing Gear Wing Truss Assembly	S84-31-555 (Ref.)
7	1	Bolt	AN4-36
8	1	Nut	AN310-4
9	1	Washer	AN960-416
10	1	Cotter Pin	AN380C2-2
11	1	Washer	S84-31-581-1
12	1	Locking Nut	S84-31-532
13	1	Nut	S84-31-534
14	1	Drag Truss Nut	S84-31-523
15	3	Shim	1075-DG-.010-2.010-3.000
16	1	Washer	S84-31-581-2
17	1	Landing Gear Hinge Pin	S84-31-526
18	1	Hydraulic Support Bracket	S84-33-893
19	1	Hydraulic Brake Installation	S84-32-501
20	1	Nut	AN320-10
21	3	Cotter Pin	AN380C3-3
22	1	Nut	AN310-7
23	1	Cotter Pin	AN380C4-5
24	1	Nut	AN320-14
25	1	Washer	1075-DH-.125-.890-1.750
26	1	Scissors Link	S84-31-519
27	1	Scissors Link	S84-31-518
28	1	Bolt	S84-31-536
29	1	Bolt	S84-31-623
30	1	Cable Assembly	S84-31-572
31	1	Nut	AN320-8
32	1	Washer	AN960-816
33	1	Terminal	S84-31-551
34	1	Nut	AC364-1414
35	1	Bolt	S84-31-551
36	3	Shim	1075-DG-.010-2.010-2.750
37	1	Washer	1075-DH-.062-.890-1.750
38	1	Washer	1075-DH-.032-.890-1.750
39	3	Bolt	AN73-4
40	1	Bolt	AN10-33
41	1	Link	S84-31-640
42	3	Washer	AN960-10L
43	1	Bracket Assembly	S84-31-626
44	1	Nut	AN320-10
45	1	Cotter Pin	AN380-C4-4
46	1	Bushing	1001-D-10-2.125

NOTE:



Lock wire required as shown.

Fairings are provided for closing the wheel wells when the landing gear is retracted. The fairing for each unit is arranged in two sections. The upper section is hinged to the center panel outboard of the pivotline and is attached to its lower end by a pivot arrangement to the shock strut. The lower section of the fairing is attached to the fork. The pivot arrangement separates the two portions of the fairing when the gear is "DOWN" so that they will not contact each other upon movement of the shock strut.

The sole purpose of the torque arms on each shock strut is to maintain the wheel track in correct position with respect to the airplane.

The wing slats are mechanically connected to the landing gear mechanism and operate automatically with extension and retraction of the landing gear as described in section IX. When the gear is down, the slats are open and vice versa. The primary actuating rod for each slat mechanism is pivoted to a tripod bracket on the corresponding landing gear drag truss.

b. Mechanical Operation.- The hydraulic phase of the landing gear extension and retraction is discussed in detail in section IX. The corresponding mechanical action is given below.

(1) Operation of "Wheel Lock".- A small lever marked "WHEEL LOCK" is located on the inboard side of the selector valve assembly. The purpose of this lever is to positively lock the landing gear lever of the selector valve in the "DOWN" position. When the landing gear lever is in the "UP" position, the lock lever is unlocked. When the landing gear lever is placed in the "DOWN" position, the lock lever locks automatically and must be released manually before the landing gear lever can be moved. The "WHEEL LOCK" lever is not connected in any way to the "UP" latches.

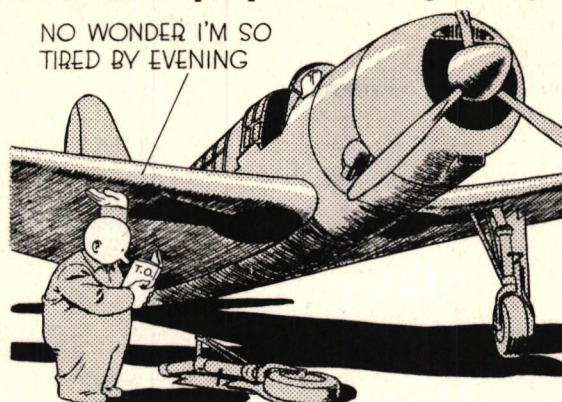
(2) Retracting the Landing Gear.- When the "WHEEL LOCK" lever is unlocked and the landing gear lever of the selector valve is placed in the "UP" position, the piston of the retracting strut starts to retract. The initial travel of the piston withdraws the plunger of the "DOWN" latch mechanism. The piston force is applied at an angle, but the roller on the plunger cross pin rolls along the straight portion of the latch mechanism. However, as the plunger reaches its fully released position, the roller moves off the straight portion of the track, and, since the plunger cannot be withdrawn farther, the force of the retracting piston acts to move the inboard end of the drag truss up, to swing the gear inboard and up around the pivot line. The roller, in the meantime, follows the curved track. The piston of the retracting strut (when properly adjusted) is fully retracted when the gear attains its fully retracted position. Also, as the gear attains this position, it engages the spring-loaded "UP" latch and cannot then be extended until the latch is released mechanically by movement of the selector valve lever.

(3) Extending the Landing Gear.- When the landing gear lever of the selector valve is placed in the "DOWN" position, the "UP" latches are first released, and hydraulic pressure then acts to extend the piston of each retracting strut. As the piston extends, the gear swings down and outboard, but the locking plunger cannot extend as long as the cross pin roller rides within the curved portion of the track. When the gear reaches the fully extended position, the roller moves onto the straight portion of the track and allows the force of the extending piston to extend the locking plunger. A projection on the drag truss engages a stop on the support assembly near the locking mechanism to stop the gear in the extended position so that the plunger will be in alignment with the mating hole in the support. When this occurs, the final travel of the extending strut piston forces the plunger into the hole to lock the gear in the "DOWN" position. The spring operating against the plunger also contributes to the locking action, but is incidental. The primary function of the spring is to hold the plunger in the locked position when hydraulic pressure is not acting. A hydraulic snubber is incorporated in the retracting cylinder to retard the movement of the strut piston as the gear nears the full down position; thus preventing undue shock or damage to the gear units when the full "DOWN" position, as determined by the stops, is reached.

c. Removal and Installation of Landing Gear.-

(1) General.- It is possible to remove the complete landing gear as a unit. However, because of weight and handling difficulties that would be encountered, it is recommended that the shock strut and drag truss assemblies be removed separately.

Refer to fig. 1-V which is a detail drawing of the landing gear. The list of parts accompanying this drawing are grouped into assembly and installation parts. Refer also to fig. 2-V which is a perspective drawing showing removal and installation details.



Prior to removal of the gear proper, certain operations must be performed as follows:

(a) Support the airplane by hoist or jacks so that the landing gear and tail wheel are free and clear of the ground.

(b) Operate the flaps to reduce the hydraulic accumulator pressure to "ZERO."

(c) Open the landing gear bypass valve (item 2, fig. 1-IX) to relieve any residual pressure in the landing gear hydraulic system.

(d) If the drag truss is to be removed, remove the cotter pin, nut, and washer (23, 68, and 108) that attach the retracting strut piston to the cross pin (109) of the locking plunger, and then collapse the retracting strut.

(e) Remove the landing gear fairing (two sections).

(f) If the drag truss is to be removed, remove the cotter pin, nut, washer, and bolt that connect the slot actuating rod to the drag truss tripod.

(g) Remove the cotter pin (23), nut (50), and bolt (66) that connect the collapsing cable clevis to the strut fitting.

(h) If the drag truss is to be removed, disconnect the flexible brake line near the top of the drag truss; plug the center panel line to prevent loss of hydraulic fluid.

(i) Disconnect the flexible brake line from the rigid line below the clamp at the lower torque arm support. Plug the flexible line, if the drag truss is not to be removed and the line has therefore not been disconnected and plugged above this point.

(2) Shock Strut Assembly.-

(a) Disconnect the clamp at the lower end of the flexible brake line from the torque arm support by removing the stop nut, washer, and bolt.

(b) Remove the cotter pin, nut, washer, and bolt (77, 78, 79, and 80) that connect the lower end of the drag truss to the shock strut.

(c) Remove the cotter pin, nut, washer, and bolt (8, 9, 10, and 11) that lock the long shaft (101) to the forward support.

(d) Remove the lock wire and unscrew the forward lock nut from the shaft (101). Loosen the lock nut (104) and adjusting nut (105) forward of the drag truss bearing.

(e) Remove the cover plate from the leading edge of the center panel forward of the shaft (101).

(f) Support the shock strut assembly; then unscrew the shaft (101) from the rear bearing pin. When the rear end is free, note the position and number of the shims (99) and remove them together with the nuts.

(g) Carefully withdraw the shaft (101) from the forward support and strut bearing.

(3) Drag Truss Assembly.-

(a) Withdraw the plunger (133) from the locking position to free the inboard end of the

drag truss and swing the drag truss inboard enough to prevent re-locking of the mechanism.

(b) Check to see that the retracting strut piston, slat actuating rod, and flexible brake line have been disconnected.

(c) Support the drag truss and pull it forward off the rear bearing. Note the number of shims (99) on the bearing behind the drag truss before they are removed.

(4) Installation Procedure.- To re-install the landing gear, employ in reverse the procedure given in part c, preceding, and in addition perform the following operations:

(a) After the brake lines have been connected, bleed the brake according to the procedure given in section IX on the Hydraulic System.

(b) Before installing the fairings, close the landing gear bypass valve (item 6, fig. 1-IX) and carefully retract the gear with the hand pump. Check the simultaneous operation of the slat mechanism, and check particularly the clearance of the entire gear in the wheel well and the engagement of the roller (85) with the up-latch as the gear reaches its fully retracted position; check the collapsed position of the shock strut and adjust the collapsing cable, if necessary. The strut should be five-eighths inch from the fully collapsed position.

d. Shock Strut.-

(1) Removal and Installation.- If it is desired to remove the shock strut only (with wheel attached) from the remainder of the landing gear, employ the following procedure:

(a) Support the airplane by hoist or jacks so that the landing gear is clear of the ground.

(b) Open the landing gear bypass valve (item 2, fig. 1-IX). This operation is required for safety of personnel only.

(c) Remove the landing gear fairing (two sections).

(d) Disconnect the flexible brake line from the rigid line below the clamp at the lower torque arm support. Plug the flexible line to prevent loss of hydraulic fluid.

(e) Disconnect the clamp at the lower end of the flexible brake line from the torque arm support by removing the stop nut, washer, and bolt.

(f) Remove the cotter pin, nut, and bolt (23, 50, and 66) that connect the collapsing cable clevis to the strut fitting.

(g) Remove the cotter pin, nut, washer, and bolt (77, 78, 79, and 80) that connect the lower end of the drag truss to the shock strut.

(h) Unlock the cap (item 4, fig. 13-IX) at the top of the shock strut, and using the special spanner wrench (S84-88-538) supplied with the airplane, unscrew it.

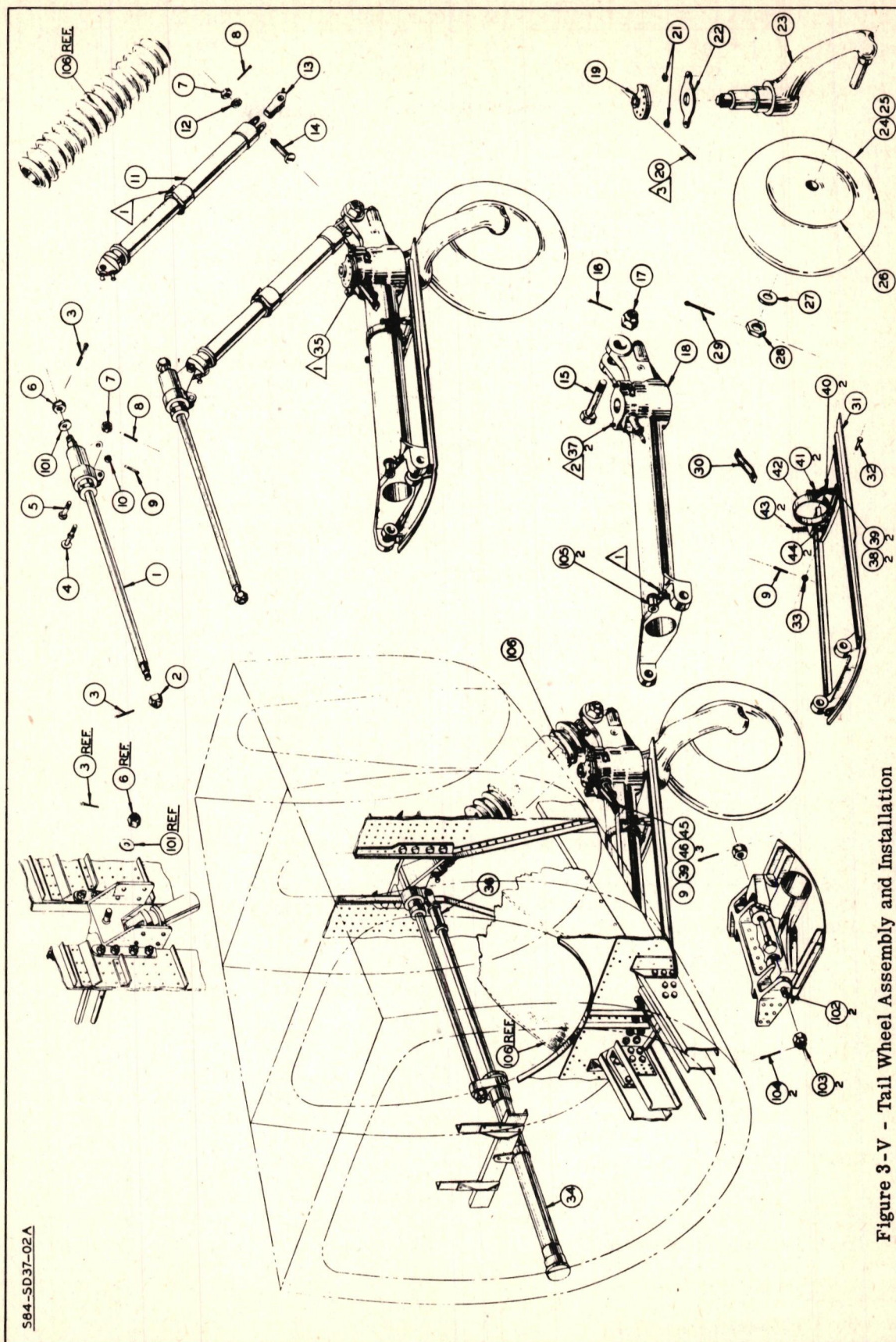
(i) Install a tool threaded No. 10-32 NF3 in each of the two locking pins. Support the strut and pull the pins out to free the strut.

(j) To install the shock strut, reverse the foregoing procedure. After installation, bleed the brake according to the procedure given in section IX on the Hydraulic System.

3. Tail Wheel Installation.

a. Description.- The tail wheel is of conventional design. It can swivel 360 degrees and has a shimmy damper which produces a stabilizing effect when the airplane is taxied over rough ground.

A swivel lock arrangement, controlled by a cable from a lever in the pilot's cockpit, is incorporated in the installation. The control arrangement is shown on fig. 3-V. The swivel lock mechanism comprises a spring-loaded pin which, unless held in the "UNLOCKED" position, is free to engage a keyway in the drag truss cam. A spring-loaded cam follower, in turn, bears



PARTS LIST - TAIL WHEEL ASSEMBLY AND INSTALLATION (LAND)

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Lock Assembly	S84-37-041
2	1	Nut	AN310-D9
3	2	Cotter Pin	AN380-C3-5
4	1	Bolt	S84-66-154
5	1	Bolt	AN29-31
6	1	Nut	S84-37-041-901
7	2	Nut	AN320-9
8	2	Cotter Pin	AN380-C4-4
9	3	Cotter Pin	AN380-C2-2
10	1	Nut	AN320-4
11	1	Oleo Assembly	S84-37-510
12	1	Washer	AN960-D916
13	1	Block	S84-37-515
14	1	Bolt	AN29-32
15	1	Bolt	AN9-30
16	1	Cotter Pin	AN380-C4-5
17	1	Nut	AN310-9
18	1	Drag Link Assembly	S84-37-914
19	1	Shoe Assembly	S84-37-921
20	1	Pin	1060-D-1-19
21	2	Nut	AC-365-428
22	1	Plate	S84-37-915
23	1	Knuckle	S84-37-913
24	1	Tire	Firestone Part No. B.D.-10716
25	1	Tube	Firestone Part No. B.D.- 10716-T
26	1	Wheel	Firestone Part No. J.O.-200
27	1	Washer	35A 239-2
28	1	Nut	35B416-1
29	1	Cotter Pin	AN380-C4-7
30	1	Guide	S84-37-536
31	1	Fairing Assembly	S84-37-930
32	1	Bolt	AN4-10
33	1	Nut	AN310-4
34	1	Retracting Strut (Ref.)	S84-SD33-12
35	1	Bolt	NAF 1164-1024-5
36	1	Piston Stop Rod	S84-37-929
37	2	Studs	626-d-1/4-1 1/8A
38	2	Bolt	AN23-8
39	3	Nut	AN320-3
40	2	Nut	AN316-4R
41	2	Spring	S84-37-926
42	1	Clamp Assembly	S84-37-925
43	2	Bolt	S84-37-927
44	2	Terminal	S84-37-928
45	1	Bolt	AN23-13
46	3	Washer	AN960-C-10
101	1	Washer	AN960-D816
102	2	Bolt	S84-37-508
103	2	Nut	AN310-6
104	2	Cotter Pin	AN380-C3-3
105	2	Guide	S82-88-361
106	1	Boot	S84-37-504

NOTES:

①

Lock wire required.

②

Set studs in white lead.

③

Peen both ends.

against the cam to move the fork and wheel into the direct fore and aft trailing position when the wheel is off the ground, so that the pin will snap into the keyway. The control lever is installed on the side of the cockpit to the left of the pilot's seat. The lever operates in a slotted guide which allows it to be fixed in the "UNLOCKED" position.

The tail wheel retracting strut is rigidly attached to the fuselage structure in a position nearly parallel to the line of thrust and forward of the remainder of the tail wheel retracting mechanism. The piston of the retracting strut extends aft and connects to the actuator of the lock assembly, a mating portion of which is, in turn, attached to the upper end of the shock strut. The lock assembly is so arranged that it may be moved in a fore and aft direction by the retracting strut piston along a round supporting guide, to retract or extend the tail wheel gear, and lock it in position when extended. Hydraulic pressure, controlled by the landing gear lever of the selector valve, retracts and extends the tail wheel gear in unison with the main landing gear, and locks it in the full "DOWN" position when extended. A complete description of the hydraulic related mechanical action is given in section IX paragraph 11. The operation of the lock assembly may be understood by referring to the sectional detail of the mechanism shown on fig. 3-IX and 12-IX. The last one-half inch of travel of the tail wheel retracting strut to the extended position operates the sleeve of the lock assembly to lock the assembly to the guide. Also as long as the piston is within one-half inch of the extended position, the lock will not release and external loads tending to retract the tail wheel gear will be transmitted through the lock assembly to the guide and not to the retracting strut piston. The retracting strut incorporates a spring-loaded mechanism to insure that the piston will be in fully extended position against vibration or extraneous loads without hydraulic pressure, but will retract readily under hydraulic pressure. Therefore, once the tail wheel is extended to the locked "DOWN" position, hydraulic pressure is not required to maintain it in that position.

A micro-switch is located at the aft end of the gear lock assembly. When the lock mechanism is not in the locked "DOWN" position, the switch plunger is released to close the switch. If the main battery switch is also closed and the throttle less than one-fourth open, the warning horn will sound.

Details of the retracting strut are shown on fig. 12-IX, and the strut is discussed in section IX.

b. Mechanical Operation.- The tail wheel gear is extended and retracted by means of hydraulic pressure in unison with the main landing gear. The hydraulic phase of these operations is discussed in detail in section IX. The corresponding mechanical action is given below.

(1) Retracting the Tail Wheel.- When the "WHEEL LOCK" lever (not "TAIL WHEEL LOCK") is unlocked and the landing gear lever of the selector valve is placed in the "UP" position, the piston of the tail wheel retracting strut starts to retract. The initial travel of the piston overcomes a spring retainer within the strut and at the same time moves the sleeve of the tail wheel lock assembly forward to release the lock. Further retraction of the strut piston moves the entire lock assembly forward along the guide to retract the tail wheel. There is no tail wheel "UP" latch. Hydraulic pressure is required to maintain the gear in the retracted position.

(2) Extending the Tail Wheel.- When the landing gear lever of the selector valve is placed in the "DOWN" position, the piston of the tail wheel retracting strut extends. When the piston is within one-half inch of the fully extended position the body of the lock assembly to which the shock strut is attached is in the full aft position. Further extension of the piston forces the sleeve to which it is attached back over the locking keys to lock the assembly to the guide. As long as the piston remains within one-half inch of the fully extended position, the lock will not release and external loads tending to collapse the gear will be transmitted through the lock assembly to the guide, and not to the retracting strut piston.

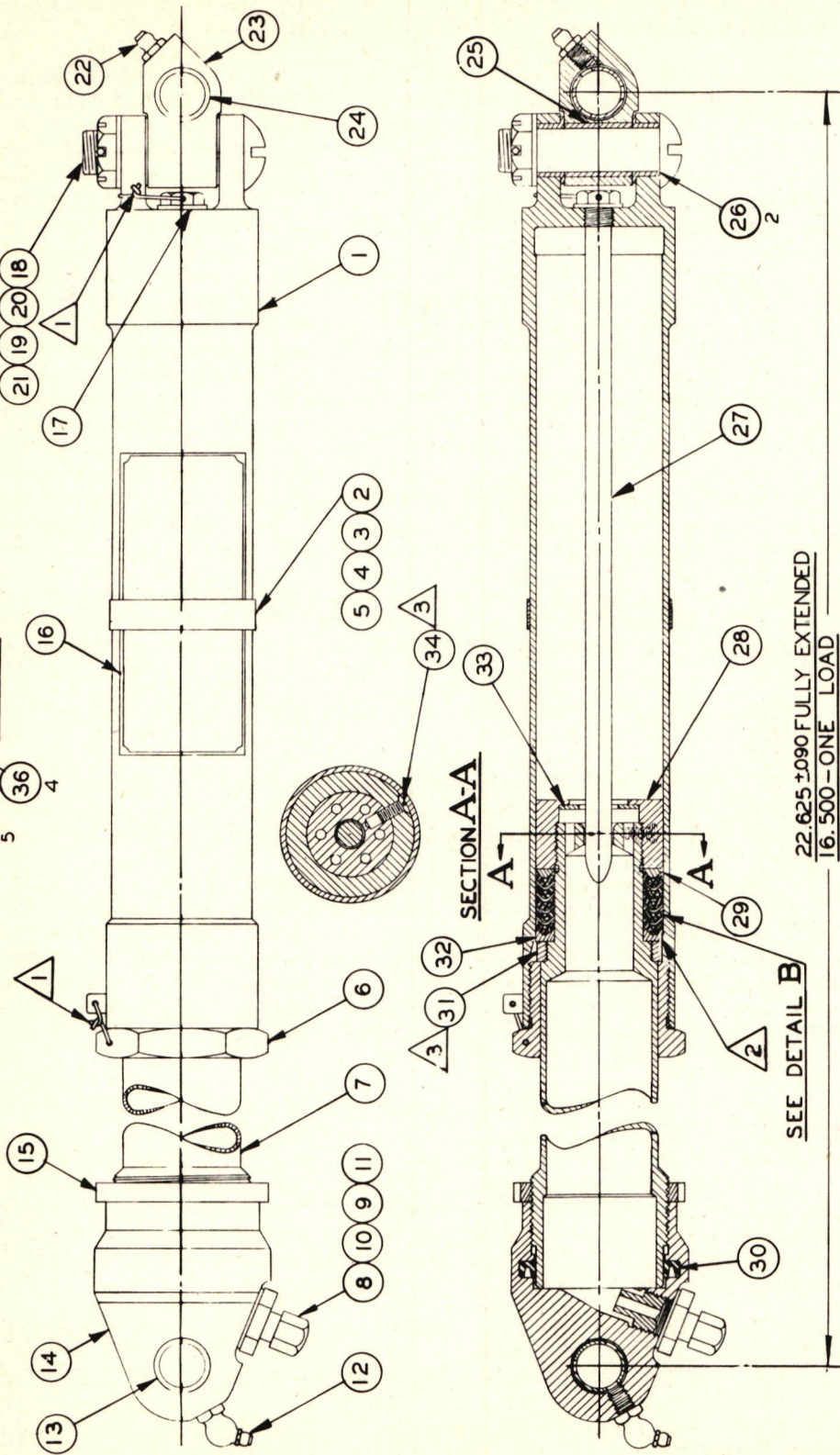
c. Removal and Installation.- Removal of the shock strut is a simple operation, but disassembly of the remainder of the gear assembly requires disconnection of the hydraulic lines to the retracting strut. The gear removal and installation procedure has therefore been divided into three parts, as follows:

(1) Chassis Assembly.-

(a) Support the airplane so that the tail wheel is clear of the ground.

SERVICE DRAWING
NO. S84-SD37-03 A

DETAIL B



22.625 ±0.090 FULLY EXTENDED
16.500 - ONE LOAD
15.125 - FULLY COMPRESSED
SEE DETAIL B

(C.W. ASSEMBLY S84-37-51Q)
Figure 4-V - Tail Wheel Shock Strut

PARTS LIST - TAIL WHEEL SHOCK STRUT

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Female Strut	S84-37-015
2	1	Clamp	735-28
3	1	Screw	AN515-8-8
4	1	Nut	AN340-8
5	1	Lock Washer	AN935-8
6	1	Nut	S84-37-909
7	1	Male Strut	S84-37-012
8	1	Valve Cap	Bendix 53083
9	1	Filler Plug	Bendix 53084
10	1	Valve Core	Dill 100 DBB
11	1	Gasket	S84-37-901
12	1	Lubricator	Alemite 1637
13	1	Bushing	1011-D-9-875-437
14	1	End	S84-37-513
15	1	Collar	S84-37-512
16	1	Name Plate	S84-37-077
17	1	Washer	S84-37-538
18	1	Bolt	S84-37-540
19	1	Nut	AN320-9
20	1	Washer	AN960D-916
21	1	Cotter	AN380-4C-4
22	1	Lubricator	Alemite 1641
23	1	Block	S84-37-515
24	1	Bushing	1011-D-9-.930-.467
25	1	Bushing	1001-D-9-.870
26	2	Bushing	1007-D-9-.312
27	1	Metering Pin	S84-37-029
28	1	Bearing	S84-37-579
29	1	Seat	S84-37-905-2
30	1	Cup Seal	914-D-1.640-A
31	1	Collar	S84-37-580
32	1	Seat	S84-37-905-1
33	1	Valve	S84-37-908
34	1	Screw	AN510B10-6
35	5	Packing	S84-37-902
36	4	Separator	S84-37-903

NOTES:

- ① Lock wire required as shown.
- ② Add washers (1075-DD-.032-1.156-1.593) if necessary between S84-37-580 and S84-37-905-1 to eliminate end play in packing and still permit rotation by hand.
- ③ Stake in place.
- ④ When installing Bendix filler plug, set threads in gas-tite.
- ⑤ For test and assembly, use hydraulic fluid, Specification No. AAF-3580, medium grade.
- ⑥ Test under 1000 pounds per square inch for 10 hours without leaking.
- ⑦ For testing, the oleo is to be operated continuously for one-half hour, but the number of cycles of operation shall not be less than 350.

(b) Disconnect the latch cable from the tail wheel chassis by removing one cotter pin, nut, washer, and clevis bolt.

(c) Disconnect the chassis assembly from the shock strut by removing one cotter pin, nut, and bolt.

(d) Disconnect the chassis assembly from the bulkhead fitting by removing two cotter pins, nuts, and bolts.

(e) To re-install, reverse the removal procedure.

(2) Shock Strut.- Disconnect the shock strut from the lock assembly by removing one cotter pin, nut, and bolt.

(3) Retracting Strut and Locking Mechanism.-

(a) Operate the flaps to reduce the hydraulic accumulator pressure to "ZERO."

(b) Disconnect the two hydraulic lines from the retracting strut and plug the lines to prevent loss of fluid.

(c) Disconnect the guide from the aft bracket by removing one cotter pin, nut, and washer.

(d) Support the retracting strut and disconnect it from the forward bracket by removing two cotter pins, nuts, washers, and bolts.

(e) Move the strut and guide forward to free the aft end of the guide; then remove the entire assembly.

(f) To re-install, reverse the foregoing procedure. After installation, the tail wheel portion of the hydraulic system will require bleeding; refer to section IX for applicable procedure.

4. Tires and Tubes.

a. Description.-

(1) The tires and tubes for the main landing gear are Goodyear, size 34 x 9 or 34 x 9.9 depending upon the wheels used.

(2) The tire and tube for the tail wheel installation are respectively Firestone No. BD 10716 and BD 10716-T.

b. Maintenance.- Tires and tubes will be inspected and maintained in accordance with the following instructions:

(1) Removal.-

(a) Tire Removal (Landing Wheel).- The landing gear wheel is of the quick demountable type. To remove the tire, proceed as follows:

1. Remove cover on front of the wheel.
2. Deflate the tire.
3. Press the valve out of the hole in wheel. Be sure it is clear as tire will have to slide sideways on rim.
4. Press evenly on each side of the rim, causing the lock ring to spring out.
5. Pull demountable rim out until it is clear of wheel.
6. Remove tire.

(b) Assembly is the reverse of removal.

(c) Tire Removal (Tail Wheel).- The tail wheel tire will be removed as follows:

1. Remove cover on front of the wheel.

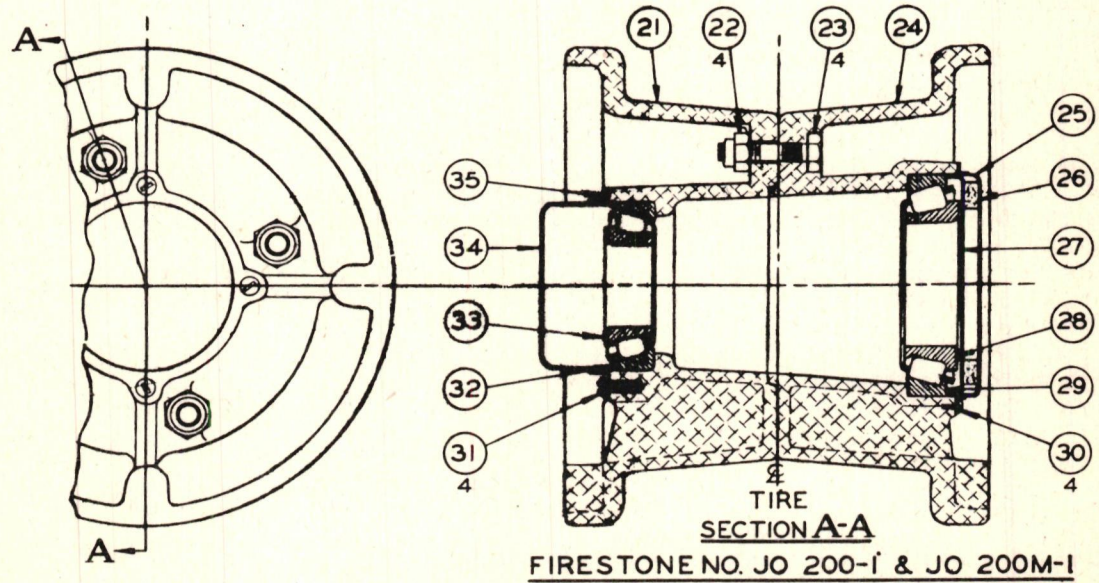
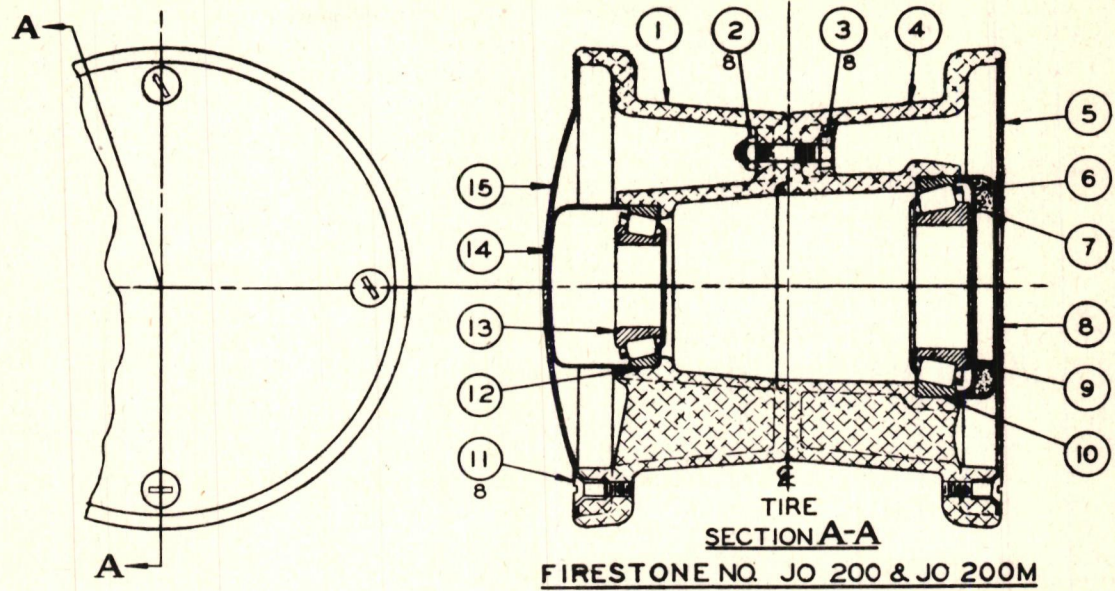


Figure 5-V - Channel Tread Tail Wheel

PARTS LIST - CHANNEL TREAD TAIL WHEEL 12-1/2 x 4-1/2

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Casting (Female)	JO-202-F *
2	8	Self-Locking Nut	AN365-1032
3	8	Bolt Assembly	JO-205-F
4	1	Casting (Male)	JO-201 **
5	1	Fairing (Male)	JO-204
6	1	Bearing Cap (Small)	JO-208
7	1	Felt Seal	JO-209
8	1	Bearing Cap (Large)	JO-207
9	1	Bearing Cone (Male Side)	Timken 19150
10	1	Bearing Cup (Male Side)	Timken 19268
11	8	Fairing Screw	JO-211
12	1	Bearing Cup (Female Side)	Timken 07196
13	1	Bearing Cone (Female Side)	Timken 07100
14	1	Bearing Cap	CO-204
15	1	Fairing (Female)	JO-203
21	1	Casting (Female)	JO-202-1 ***
22	4	Self-Locking Nut	AN365-428
23	4	Bolt Assembly	JO-205
24	1	Casting (Male)	JO-201-1 *A*
25	1	Felt Retainer	JO-213
26	1	Felt	JO-214
27	1	Inboard Retainer	JO-215
28	1	Bearing Cone	Timken 19150
29	1	Bearing Cup	Timken 19268
30	4	Screw	Parker Kalon (4A-B x 1/4) 6CP41
31	4	Retainer Screw	AN515-5-6
32	1	Bearing Cup	Timken 07204
33	1	Bearing Cone	Timken 07100
34	1	Outboard Retainer	JO-218 *B*
35	1	Retainer Ring	JO-217 *B*

NOTES:

1. JO-200 and JO-200-1 are aluminum alloy assemblies.
JO-200M and JO-200M-1 are magnesium alloy assemblies.
 2. Parts as listed are for JO-200 and JO-200-1 assemblies.
 3. All numbers are Firestone unless otherwise noted.
 4. Tire, tube, and wheel assembly complete is Firestone Co. No. CD10843.
- * For JO-200M this part is JO-202FM.
 ** For JO-200M this part is JO-201M.
 *** For JO-200M-1 this part is JO-202M-1.
 A For JO-200M-1 this part is JO-201M-1.
 B These parts are Firestone Co. assembly JO-216.

2. Deflate the tire.
3. Press the valve out of the hole in wheel.
4. Remove 8 No. 365-1032 nuts from bolts which hold wheel together. (Do not drive bolts out of wheel unless they are damaged.) The bolts have been broached under the head and are supposed to retain their position.
5. Remove dust cover, wheel retaining nut, and bearing.
6. Carefully pull wheel apart.
7. Remove tire.

(d) Reassembly is the reverse of removal with the following additions:

1. When the wheel is reassembled be sure that the halves go together properly. Do not try to force the parts together as they are machined to fit without a great deal of pressure.
2. Adjust bearing as described in section IX paragraph 11.

(2) Inspect the casings for the following defects.-

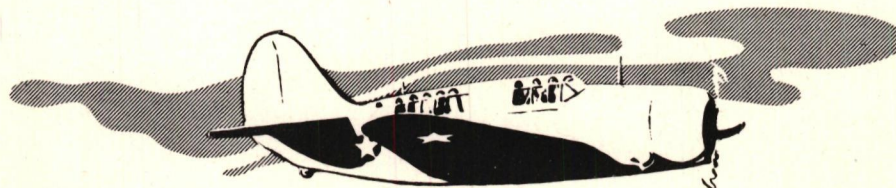
- (a) Inside of carcass for ruptures or breaks.
- (b) Beads for physical damage extending through the outside rubberized chafer fabric.
- (c) Sidewalls, both inside and out, for breaks, cuts, blisters, loose cords, or other serious physical damage.
- (d) Tread for cuts-through or exposing the fabric carcass to moisture or dirt.
- (e) Tread wear exposing the fabric casing.

(3) Inspect the tubes for the following defects.-

- (a) Valve for physical damage or faulty attachment to the tube.
- (b) Tube body for evidence of wrinkles and creases.
- (c) Tube body for thin spots, cuts, or punctures.
- (d) Chafing of the tube due to rubbing of bead.
- (e) Damaged areas resulting from casing breaks.

(4) Inspect wheel rim as follows.-

- (a) Clean rim, if corroded.
- (b) Examine rim for cracks or damage due to careless use of tire mounting tools, or impact from any object.
- (c) Renew protective coating of paint if worn through.

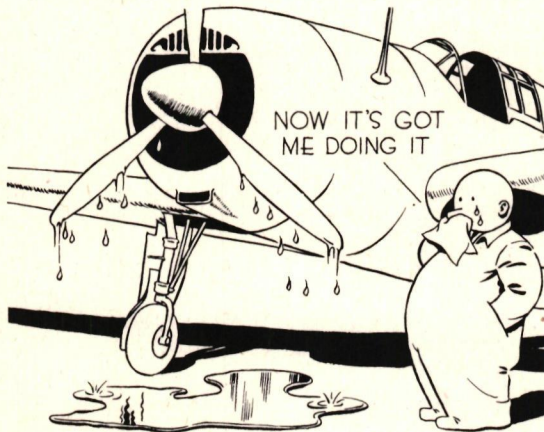


Section *IV*

ANTI-ICER SYSTEM

1. General.

The anti-icer system supplies fluid as required to the propeller. Fig. 1-IV shows the system in perspective. The system is conventional, employing a tank, motor-driven pump, propeller slinger ring and the necessary lines and fittings. The anti-icer pump is controlled and regulated by a breaker switch and rheostat on the main switch box.



2. Anti-Icer Fluid Tank.

The anti-icer fluid tank is located below the cockpit floor at the left side of the fuselage, aft of the fire wall. The tank is vented at the top. A line from the bottom connects to the pump. The tank is held in place by two padded straps which are attached to the fire wall fittings with cap screws.

The fluid to be used in the system is specified in section VII of this Handbook.

3. Anti-Icer Pump, Adel Number D8300-2-3.

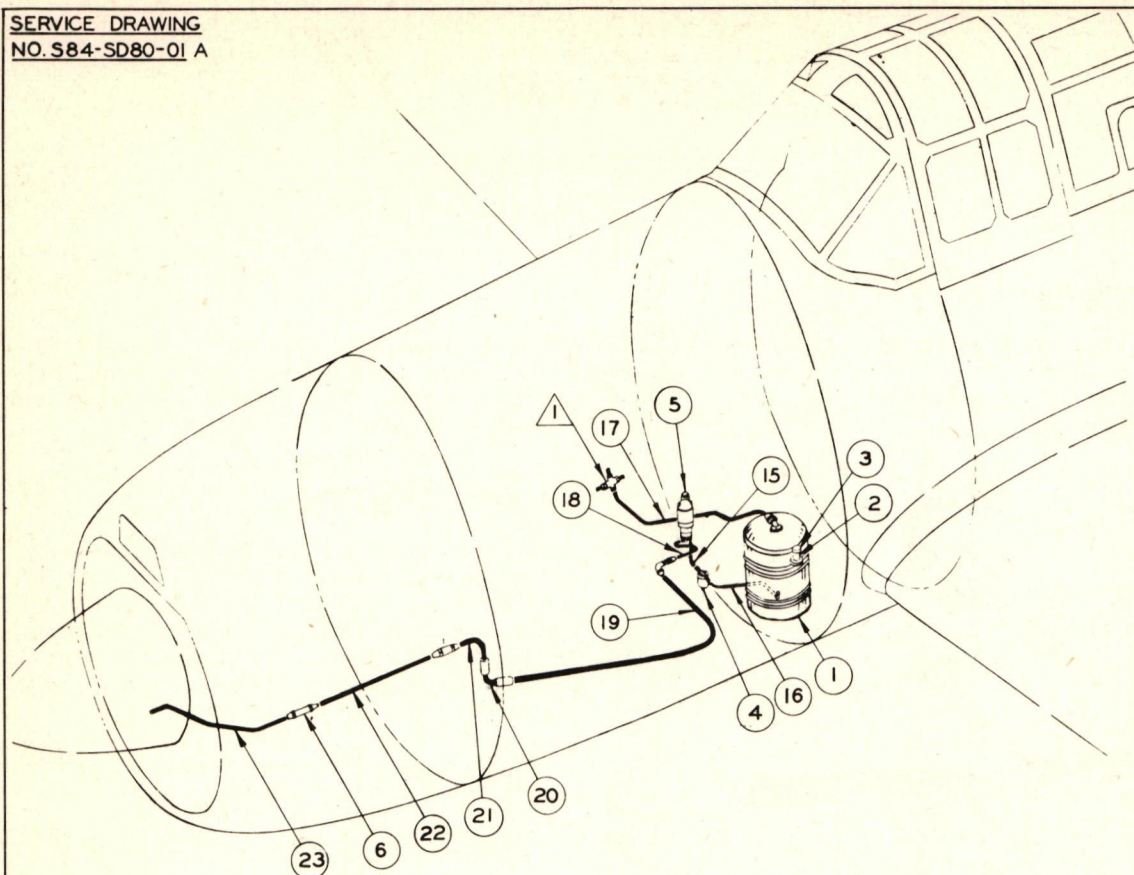
a. Description.- Details of the anti-icer pump are shown on fig. 2-IV. The complete assembly is Adel part No. D8300-2-*, consisting of pump assembly D8310-1, motor assembly G8305-2, and several miscellaneous parts as shown on the drawing. The motor and pump assemblies are held together by three Allen-head cap screws. (*See note, page 5, this section.)

The motor assembly employs a specially wound motor with an armature mounted on selected, double sealed precision ball bearings. The motor is completely enclosed in a cast aluminum alloy housing and does not require the introduction of outside air for cooling. Because of this ability to operate without provision for circulating air, the entire motor assembly is hermetically sealed, thereby eliminating the possibility of ignition of explosive vapors present. In addition to providing a distinct safety feature, this design contributes materially to the life of the equipment by eliminating destructive action of dust, grit, and moisture.

The motor drives the pump through a simple universal coupling which rotates in an independent chamber located between the pump and motor assemblies.

The pump chamber has a corrosion-resistant steel rotor with slots containing hard-chrome plated rollers. The rotor and rollers rotate within a corrosion-resistant steel sleeve.

This unit is backed up on each end by a special "Ni Resist" alloy bearing. The bearing holes are accurately lapped to correct fits on the shaft. These two bearings, along with the sleeve, are tapered and are accurately pressed into a tapered hole in the dural rotator. The whole pumping chamber is effectively sealed off by means of a rotating seal, consisting of a ring made of copper-carbon compound. This ring rotates with the shaft and bears and seals against the pump bearing. A synthetic rubber ring rotates with both the ring and shaft and seals against the ring and around the shaft. By means of drilled passageways in the shaft, the small groove on the shaft between the copper-carbon ring and the pump bearing is connected to the inlet side of the pump at the front end of the housing. Until the seal deteriorates or becomes damaged, leakage is impossible, due to the fact that any fluid finding its way past the pump bearing is immediately evacuated through the drilled passageways by the natural suction of the pump. This type of assembly results in maximum resistance to corrosion and wear; eliminates the possibility of "freezing" and leakage; and insures a low friction factor for service.



SEE ITEM "AD" S84-SD 33-20A - BOMB
DOORS & DISPLACING GEAR HYD. SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Propeller Anti-Icer Tank	S84-80-014 *
2	1	Strainer	S84-80-535 **
3	1	Filler Cap	S84-80-569 **
4	1	Filter	Adel A-7979
5	1	Anti-Icer Pump	Adel D-8300-2-4 *** Model J2.5-24D-4 1/8
6	1	Restrictor	Adel A-10003-1

* Tank set with filler neck outboard as shown on units 171 and up. On units prior to 171, the filler neck is on the inboard side.

** These items are part of propeller anti-icer tank S84-80-014.

*** This pump used on unit 101 and up. Units prior to 101 use Adel Part No. D-8300-2-3.

Figure 1-VI - Propeller Anti-Icer System

LINE ASSEMBLIES - PROPELLER ANTI-ICER SYSTEM

Ref.	Part No.	Quan.	Location	Size	Stock		Material	End Fittings	
					Lgth.				
15	S84-80-502-502	1	Anti-Icer Pump Filter	1/4OD x .035	11.00		Alum.A1.52SO	AN818-4D AN819-4	AN818-4D AN819-4
16	S84-80-502-25	1	Filter to Anti-Icer Tank	1/4OD x .035	12.00		Alum.A1.52SO	AN818-4D AN819-4	AN818-4D AN819-4
17	S84-80-502-7	1	Anti-Icer Tank to Cross	1/4OD x .035	40.00		Alum.A1.52SO	AN818-4D AN819-4	AN818-4D AN819-4
18	S84-80-502-11	1	Anti-Icer Pump to Fitting at Fire Wall	1/4OD x .035	10.00		Alum.A1.52SO	AN818-4D AN819-4	AN818-4D AN819-4
19	S84-80-502-509	1	Fitting at Fire Wall to Hose	1/4OD x .042	50.00		Alum.A1.52SO	AN818-4D AN819-4	None *A*
20	S84-80-502-19	1	Hose to Hose	1/4OD x .035	6.00		Alum.A1.52SO	None	None
21	S84-80-502-17	1	Hose to Fitting at Shroud	1/4OD x .035	12.00		Alum.A1.52SO	AN818-4D AN819-4	None
22	S84-80-502-5	1	Fitting at Shroud to Restrictor	1/4OD x .035	33.00		52SO Al.	AN818-4D AN819-4	AN818-4D AN819-4
23	S84-80-502-23	1	Restrictor to Sling Ring	1/4OD x .035	21.00		Alum.A1.52SO	AN818-4D AN819-4	None

A This tube assembly used on units 411 and up. Prior to unit 411, the following two tube assemblies are used.

S84-80-502-21	1	Fitting at Fire Wall to Fitting	1/4OD x .035	12.25		Alum.A1.52SO	AN818-4D AN819-4	AN818-4D AN819-4
S84-80-502-3	1	Fitting to Hose	1/4OD x .035	40.00		52SO Al.	AN818-4D AN819-4	None

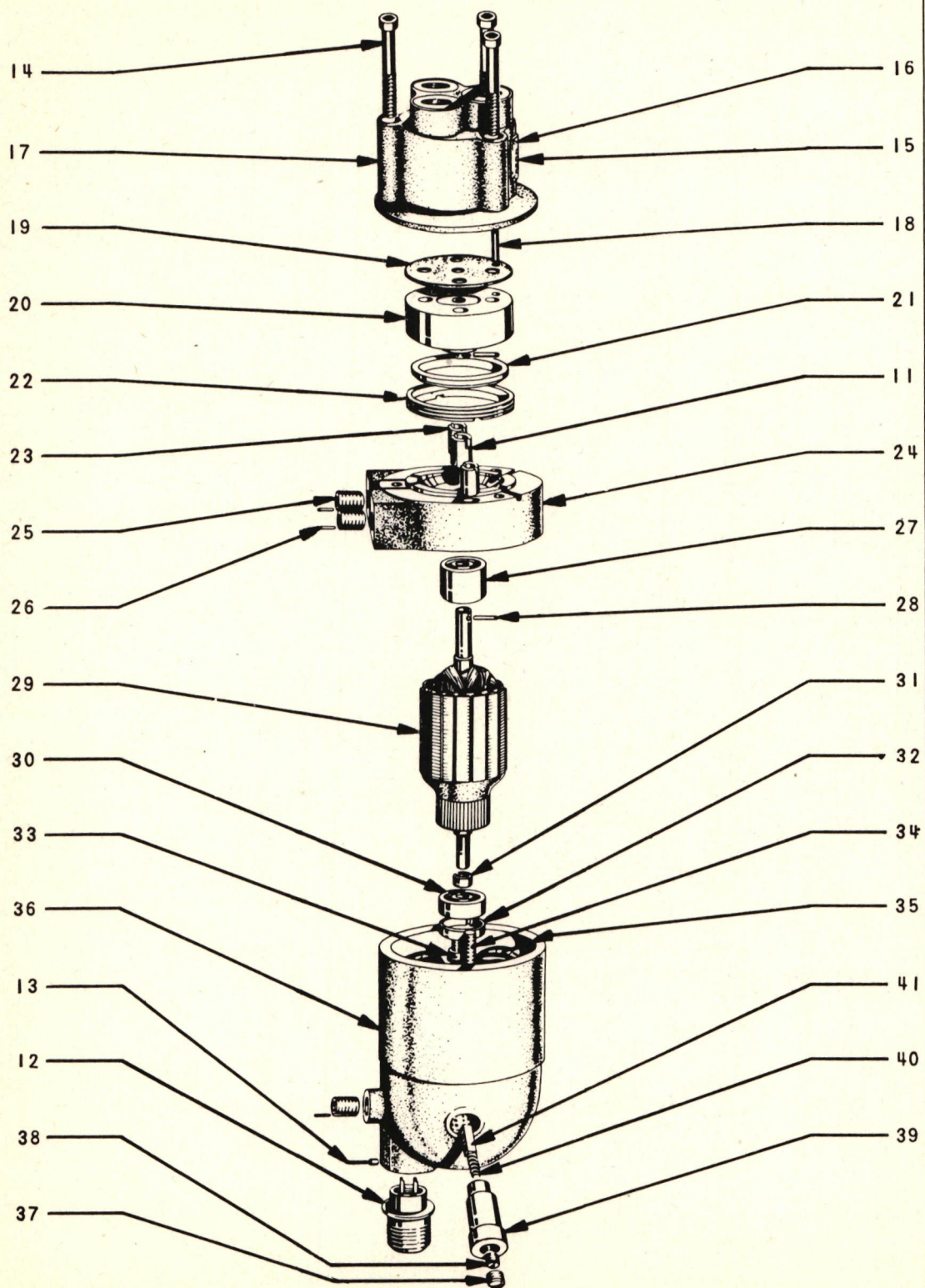


Figure 2-VI - Anti-Icer Pump

ANTI-ICER PUMP (ADEL ASSEMBLY NO. D8300-2-3)

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
	1	Complete Assembly	D8300-2-3 *
11	1	Coupling	A8333
12	1	Electrical Connector	B8381-3 *
13	2	Set Screw	A7831
14	3	Allen-Head Cap Screw	#10-32 x 1-1/2" 1g.
15	1	Name Plate	S302
16	4	Drive Screw	AN535-0-2
	1	Pump Assembly	D8310-1
17	1	Pump Housing	D8311-1
18	1	Dowel Pin	A8334
19	1	Gasket	A8353
20	1	Stator Assembly	B8320-1
21	1	Equalizer	A8315
22	1	Lock Ring	A8316
	1	Motor Assembly	G8305-2
23	2	Shell Nut	A8342
24	1	Mounting Plate	D8312
25	3	Insert	A8317
26	3	Insert Lock Pin	A8318
27	1	Bearing (Front)	A7832
28	1	Pin	A8332
29	1	Armature	D8371-2
30	1	Bearing (Rear)	A7845
31	1	Shaft Spacer	A8362
32	1	Bearing Spacer	A8363
33	2	Field Lock Nut	A8347
34	2	Stud	A8341
35	1	Field Coil	D8372-2
36	1	Motor Housing	G8313
37	2	Brush Cover Screw	A7868
38	2	Brush Adjusting Screw	A7867
39	2	Brush Holder	A7869
40	2	Brush Spring	A7866
41	2	Brush	A7865

* Assembly No. D8300-2-3 with connector No. B-8381-3 used on airplanes No. 41-18774 through 41-18873. Assembly No. D8300-2-4 with connector No. B-8381-4 used on airplanes No. 42-79663 and up.

The rotator assembly cartridge is located in respect to the housing by the use of a dural dowel pin. A composition gasket, between the cartridge and pump housing, seals off the inlet and outlet chambers. The hardened, corrosion-resistant steel rotor revolves in the two solid bearings, selected because of superior efficiency (compared to a precision ball bearing operating in a liquid or isolated by an additional liquid seal, with attendant friction losses). An oil-impregnated type of bearing at these points is not feasible because of chemical action introduced by glycerine which is present in certain anti-icer fluids.

b. Maintenance.-

(1) General.- Due to the simplified construction, no adjustment of anti-icer pump should be necessary between overhaul periods with the possible exception of brush adjustment. If the overall length of the brushes becomes less than 5/16-inch, they should be replaced. Refer to figure 2 for part number. The brushes may be removed as follows:

Unscrew outer sealing cap.
Unscrew inner adjusting screw.
Using a pair of tweezers, remove spring and brush assembly.

Assembly is the reverse of the removal. Electrical and fluid connections should be checked along with security of mounting at each engine change. No periodic lubrication of the anti-icer pump is required. The sealed ball bearings are grease-packed for life.

(2) Service Troubles and Repair.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
(a) Fluid leaks out at three slots between pump and motor.	1. Copper-carbon seal has become damaged. 2. Synthetic rubber seal has deteriorated or become cracked.	a. Replace entire stator assembly cartridge. (Refer to parts list for number.)
(b) Pump meters unevenly or fails to develop rated pressure (internal leak).	1. Gasket between pump housing and stator assembly is damaged. 2. Stator assembly cartridge has internal leak.	a. Replace gasket. (Refer to parts list for number.) b. Replace entire stator assembly cartridge. (Refer to parts list for number.)
(c) Pump cannot be turned over by motor.	1. Stator assembly cartridge has become jammed or damaged.	a. Replace entire stator assembly cartridge. (Refer to parts list for number.)
(d) Motor will not function or operate.	1. Item 1. (c). 2. Brushes are worn out. (If shorter than 5/16 inch.) 3. Commutator requires seating. 4. Wiring on armature is shorted. 5. Wiring on field coil is shorted. 6. Armature shaft bearings are injured or worn out.	a. Item 1. (c). b. Replace brush and spring assembly. (Refer to parts list for number.) c. Reseat. d. Replace armature or send old armature to factory for proper servicing. (Refer to parts list for number.) e. Replace field coil or send to factory for proper servicing. (Refer to parts list for number.) f. Replace bearings. (Refer to parts list for number.)

4. Slinger Ring.

From the pump a discharge line passes through the fire wall and along the lower left side tube of the engine mount to the propeller. The forward end of the tube discharges in the conventional manner into the slinger ring attached to the propeller hub. Short tubes from the slinger ring discharge fluid into collector units attached to the blades. Each collector unit is free to move with the blade to which it is attached, since it is not physically connected to the slinger ring discharge tube.

All of the anti-icer lines are .035 x 1/4 inch 52SO aluminum alloy tubing.

Section VII

GROUND HANDLING



1. General.

Provisions are made for hoisting, jacking, towing, parking, and mooring of the A-25A Airplane. Leveling lugs are installed on the front cockpit sills. Covers are provided for the propeller hub, power plant, and cockpit enclosure.

2. Hoisting.

a. Complete Airplane.- The entire airplane can be hoisted in a three-point attitude by means of hoisting sling No. S84-74-501, attached as shown on fig. 1-VII.

(1) To install the hoisting sling.-

(a) Insert each forward sling terminal in the socket provided below the windshield and turn one-quarter turn to right to lock.

(b) Open the forward cockpit hatch and attach the aft sling fork to the turnover structure with the pin provided and safety with attached safety pin.

(c) As slack is taken up prior to hoisting, check to see that all terminals are properly installed and locked. The airplane may then be hoisted.

(d) When not in use, the hoisting sling will be stowed in the compartment provided between the cockpits. (See location on fig. 1-VII.)

(e) A hoisting sling No. S84-74-501 is provided for each A-25A Airplane.

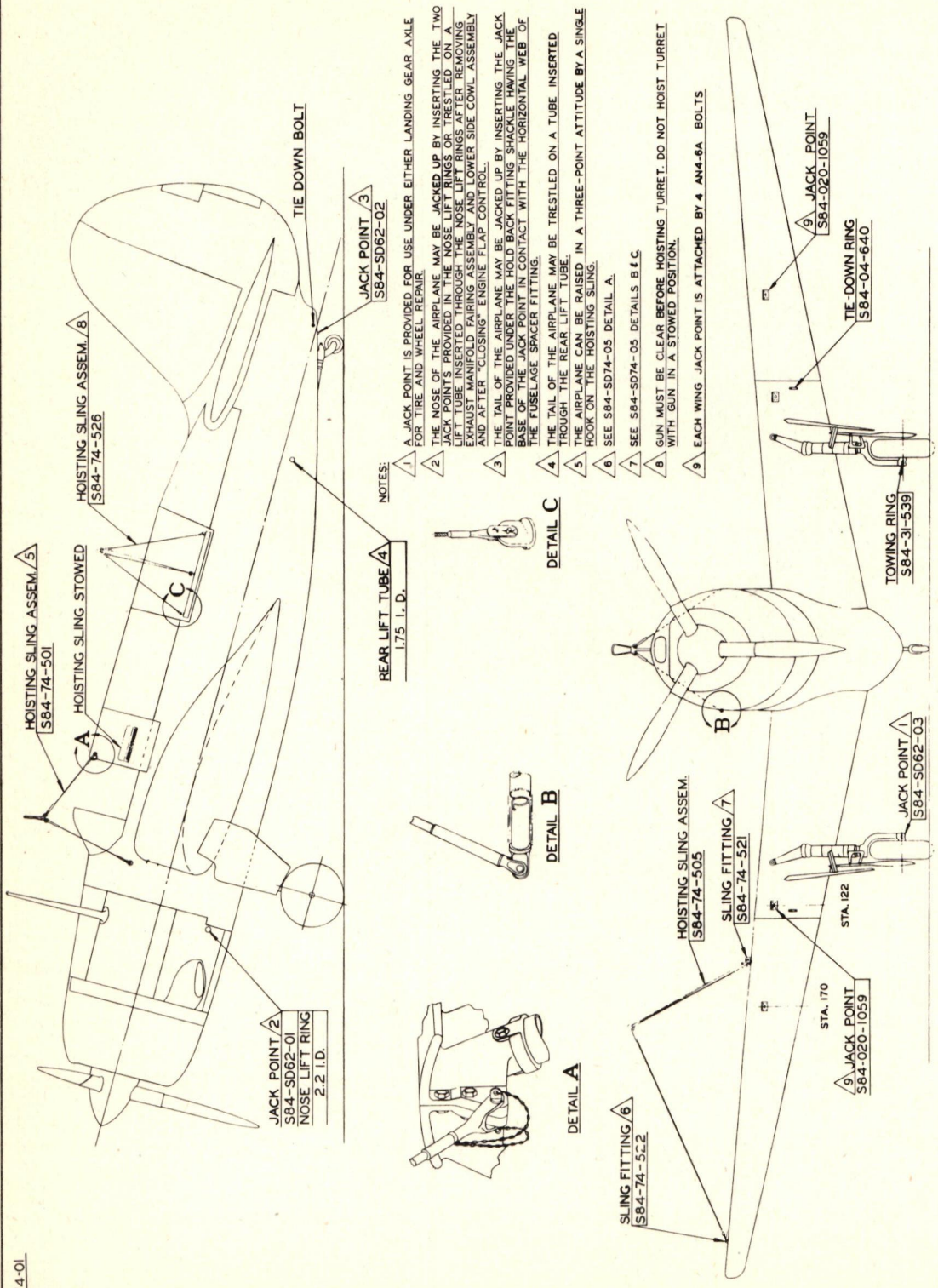
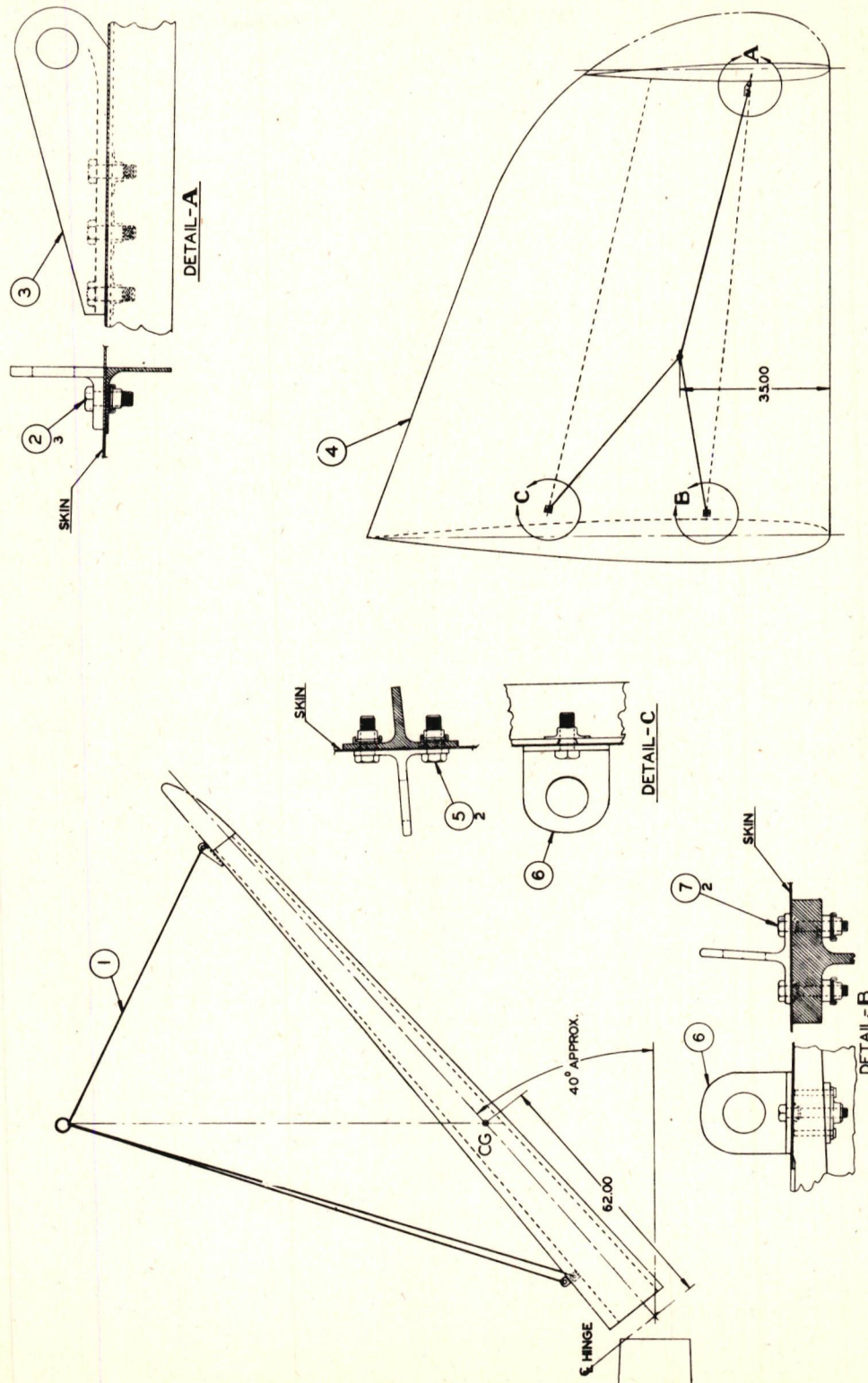


Figure 1-VII - Jacking, Hoisting, Towing, and Mooring Diagram

S84-SD74-05A



(CW ASSEMBLY S84-74-505)

Figure 2-VII - Outer Panel Hoisting Diagram

PARTS LIST - OUTER PANEL HOISTING DIAGRAM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Sling Assembly	S84-74-505-1
2	3	Bolt	AN74-7
3	1	Sling Fitting	S84-74-522
4		Outer Panel (Ref.)	S84-03-501
5	2	Bolt	AN74-10
6	2	Sling Fitting	S84-74-521
7	2	Bolt	AN74-13

b. Outer Panels. - One left and one right panel hoisting sling assembly No. S84-74-505 is provided for every four airplanes. The left assembly, with all miscellaneous parts provided, and installation details are illustrated on fig. 2-VII. Anchor nuts are permanently installed to receive the bolts of the sling fittings. The proper sling to use (left or right) may be identified easily by noting that the aft inboard cable is the longest of the three.

Before hoisting the outer panel preparatory to removing it from the center panel, disconnect any rigidly attached lines or controls (except on airplanes having wing folding provisions). As slack is taken up in the cables prior to hoisting, check to see that the cable terminals are properly hooked into the eyes of the fittings. Take up only the slack in the outboard cable while the lower panel hinge points are still connected to the corresponding center panel fittings, then adequately support the outboard end of the outer panel and remove the lower hinge bolts (or pins of the folding mechanism). Hoist the outboard end of the panel toward the position shown on fig. 2-VII, keeping both inboard cables slack. The hoisting equipment should be so located that the slack of the inboard cables is just disappearing as the outer panel attains the position shown on fig. 2-VII. The upper hinge bolts may then be removed to free the panel.

CAUTION: Be sure that only tension due to the weight of the outer panel is allowed to develop in the two inboard hoisting cables. If additional load of the airplane due to the center panel hinge connections is placed on the outer panel hoisting sling, the hoisting fittings may pull out or the cables may break.

c. Turret. - One turret hoisting sling assembly No. S84-74-526 is provided for each airplane. The four cable terminals are numbered one through four and must be attached to the corresponding eyebolts on the turret ring. With the sling thus installed, the complete turret may be hoisted out of the cockpit after properly disconnecting it from the airplane structure. Before removing or installing the turret, place the airplane in level flight position and attach at least 400 pounds of ballast to a bar through the aft left tube (see fig. 1-VII), or tie down from the same bar. Employ a hoist of at least one ton capacity. When installing the turret, lower it carefully into the airplane and guide the swivel assembly through the hole in the floor. When the turret's hoisting sling is not in use, it should be stowed in the tool kit.

d. Engine and Power Plant. - An engine hoisting sling, Wright Aeronautical Corporation No. 83304, is furnished with each R-2600-8 engine. This sling should be used to hoist only the engine and accessories attached directly to it, as illustrated on fig. 3-XIII.

When the complete power plant, including the engine mount and equipment attached thereto, is to be hoisted as a unit, the engine hoisting sling plus additional equipment as illustrated on fig. 3-VII, must be employed.

(1) Engine Only. - To hoist the engine only, refer to fig. 3-XIII and attach the hoisting sling, WAC No. 83304, according to the following instructions:

Remove the cotter pins and nuts from the exhaust rocker hub bolts of No. 2 and 13 cylinders and from the intake rocker hub bolts of No. 3 and No. 14 cylinders.

S84-SD74-03

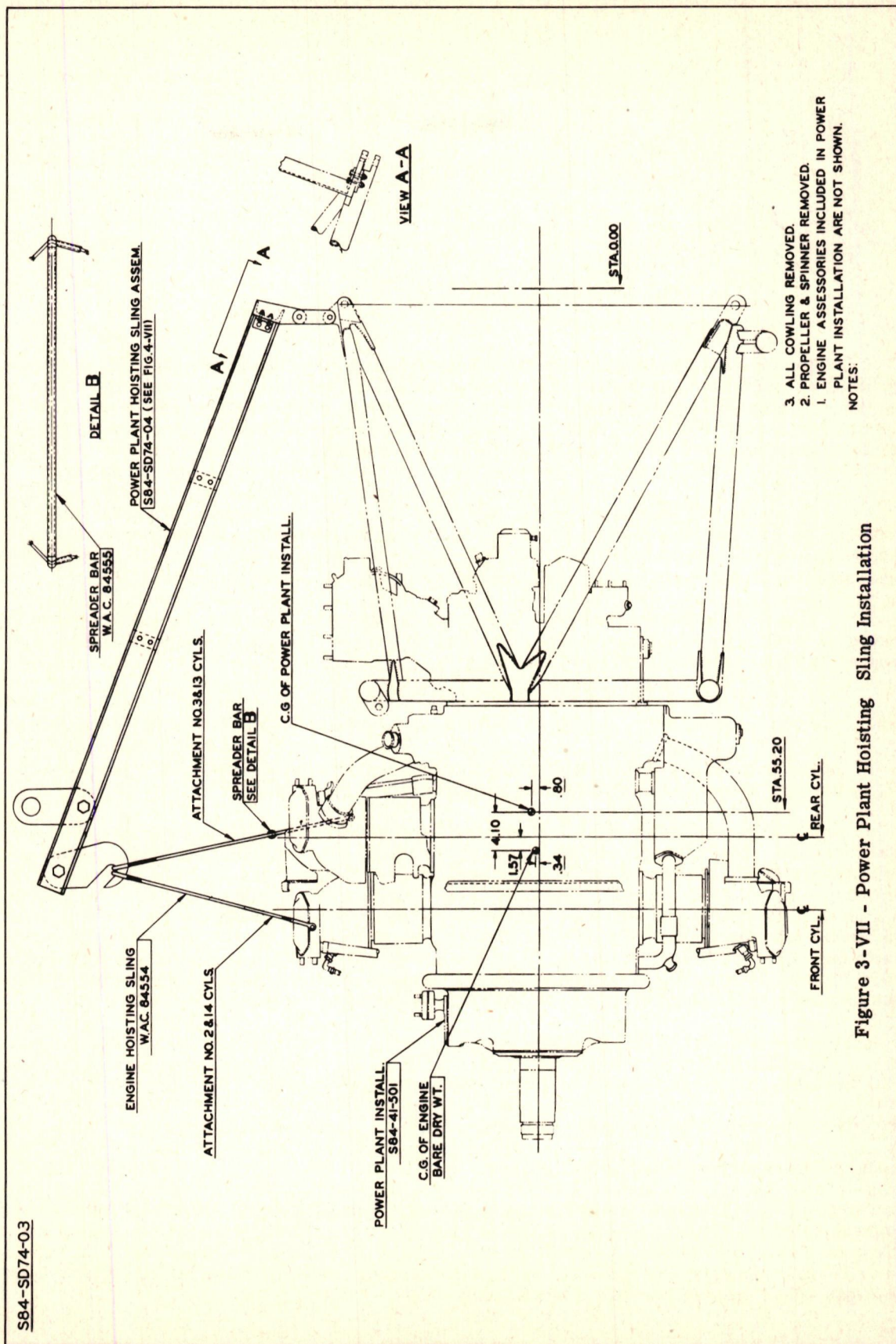
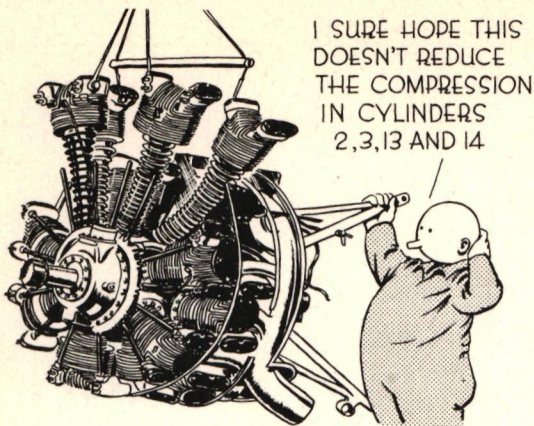


Figure 3-VII - Power Plant Hoisting Sling Installation



CAUTION: DO NOT HOIST THE COMPLETE POWER PLANT WITH THE ENGINE SLING ALONE; TO DO SO MAY SERIOUSLY DAMAGE THE ENGINE.

Install cable attaching plates by inserting the round, slotted ends of rocker hub bolt nuts into the drilled holes of attaching plates. Screw the hub bolt nuts onto rocker hub bolts slotted ends first. Leave spherical washers on hub bolts.

Attach the two spreader bar cables to the cable attaching plates installed on the No. 3 and No. 13 cylinders. Attach the free cables to the plates installed on the No. 2 and No. 14 cylinders.

Install the spreader bar (84555) to separate the rear cable as shown.

Employ hoisting equipment of at least two tons capacity and hook to the apex of the hoisting sling as illustrated. Do not hoist the engine until the airplane or stand from which it is to be removed is positioned, so that the planes of the cylinders are vertical, and the hoist is positioned directly over the engine so that the load is uniformly distributed to the sling cables. Transfer the engine load carefully to the hoist, as the engine is detached from its supporting structure so that the load of the airplane or stand will not be applied to the sling through the engine.

(2) Complete Power Plant.— Special equipment in addition to the engine hoisting sling is required for hoisting the complete power plant. This additional equipment consists of a hoisting beam assembly as detailed on fig. 4-VII. This assembly is not furnished with the airplane or engine, but all information necessary for its construction is shown on figure 4-VII.

The hoisting beam assembly, S84-SD74-04, has been specially designed for use in connection with WAC sling No. 83304 for hoisting the complete A-25A power plant installation. It should be employed as directed herein.

To hoist the complete power plant (less propeller and cowling), refer to fig. 3-VII and install the hoisting sling, WAC No. 83304, on the engine in the manner specified in (d) preceding.

Attach the aft portion of the hoisting beam assembly, S84-SD74-04, to the two lugs on top of the two aft ends of the upper engine mount members as shown.

Attach a hoist of at least two ton capacity to the top fitting of the hoisting beam and place the apex of the engine hoisting sling on the forward hook of the hoisting beam. Adjust the hoist to take the slack out of the engine hoisting sling.

Do not hoist the power plant assembly until the airplane or stand from which it is to be removed is positioned so that the planes of the cylinders are vertical and the hoist is positioned directly over the top fitting of the hoisting beam. Transfer the power plant load carefully to the hoist as the engine mount is detached from its supports so that the load of the airplane or stand will not be applied to the hoisting sling through the engine and mount.

3. Jacking.

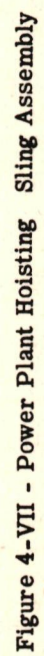
The jacking provisions for the airplane are shown on fig. 1-VII. Jack points are furnished with the airplane as loose equipment. The following instructions and precautions should be carefully observed when jacking the airplane.

In operating the jacks to raise the airplane, good judgment by the personnel using the jacking equipment must be relied upon. Yawing moments due to winds, under some conditions, may cause the jacks to flex and clamp alarmingly as they are used in the fully extended position. In this case, shoring should be used to reduce yawing or swaying when operating landing gear during periodic checks. Under no conditions will airplane jacks be subjected to loads exceeding their vertical capacity. Airplane will be headed down-wind and in no case raised when exposed to winds whose velocity is greater than 15 mph.

Section VII

RESTRICTED

7



PARTS LIST - POWER PLANT HOISTING SLING ASSEMBLY

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Hook	3/4 x 5 x 10
2	1	Attachment Plate	3/4 x 4 x 9
3	2	Bolt	AN12-22
4	2	Nut	AN310-12
5	2	Cotter Pin	AN380-4-5
6	4	Bolt	AN14-17
7	10	Nut	AN310-4
8	10	Cotter Pin	AN380-2-2
9	2	Channel, 1/4-inch Web	3 x 1.5 x 65.3
10	2	Bolt	AN7-16
11	2	Nut	AN310-7
12	2	Cotter Pin	AN380-3-3
13	4	Bolt	AN4-6
14	2	Bolt	AN4-22
15	2	Angle, 1/4-inch Flanges	1.25 x 1.25 x 2
16	3	Spacer	.75 x 1.25 x 3
17	2	Fitting	.50 x 2 x 6
18	4	Fitting	.25 x 1.5 x 5.5
19	1	Channel, 1/4-inch Web	3 x 1.5 x 35.5

NOTES:

- ① Drill through .750 - 2 holes.
- ② Drill through, "E" (.250) 10 holes.
- ③ Drill through .438 - 6 holes.
- ④ Weld - 7 fitting to - 4 channel. Weld inside channel.

5. Except for AN parts, standard cold-rolled structural steel is used throughout assembly.

When raising airplanes, all jacks will be operated simultaneously insofar as possible to equalize the loads, and in order to maintain the wings in a horizontal position at all times.

The pump handle should not be kept on the valve except when raising or lowering jack, as the valve may be permanently damaged if the handle is stepped on. Likewise, the power unit, if removed from the jack during jacking operation, should be returned to its original position on the jack to prevent damage from movement of shop equipment.

No attempt shall be made to lock the hydraulic ram in position by using clamps. If a jack should leak, it is better to allow the ram to settle slowly than to risk the possibility of its dropping suddenly when releasing the clamp. In the event it becomes necessary to leave the airplane unattended for any length of time, while supported on hydraulic jacks, care will be taken to see that ladders and other equipment are not located in such position that they will cause damage to the airplane, in the event of leakage of the cylinders on the jacks, and that the airplane is further supported by hoists from above or shoring below.

The various methods of jacking the airplane are broken down as follows:

a. Main Wheel. - A jack point is inserted into the lower end of the wheel fork on the main landing gear for jacking the airplane to remove the wheel and tire. The jack should be in accordance with AAF Specification No. 40411 or 40412. When raising one wheel, the other wheel should be properly blocked.

b. Tail Wheel. - The tail of the airplane may be raised by inserting the proper jack point in place as shown on fig. 1-VII. Jack, Specification No. 40412, with six-inch adapter can be used.

On airplanes having the hold-back shackle installed, this shackle should be pulled down and the jack point inserted. The shackle is let back in place and serves to hold the jack point. The front wheels must be blocked before the tail of the airplane is jacked. Do not raise the tail of the airplane excessively as this will produce a forward load on the jack tending to unseat or overturn the jack.

c. Wing.- Provisions are made for inserting jack points in the wing. A jack, Specification No. 40415, with one extension per leg can be used. Airplanes not having provisions for wing jacks should be jacked at engine mount lift rings. Refer to paragraph (5) of this section.

When the entire airplane is to be raised, yaw may be eliminated by arranging a rope sling around the fuselage tail structure and from this sling extending ropes from each side of the fuselage to anchor points on or near the ground, and by securing the airplane at the wing mooring rings by ropes tied to these rings and running fore and aft to anchor points located on the ground several feet to the front and rear of the mooring rings.

In some localities, when the airplane is supported on jacks in the open, it may be necessary to protect personnel against the possibility of jacks being overturned by using one of the following means.

(1) Heavy timber cribbing, the top members of which are felt-padded and snugly fitted under the wing spars, extending along three or four feet of the span.

(2) Large felt-padded timbers that fit the chordwise contour of the wing, extending several inches at the front and rear of the spars, and supported with wooden horses or stands of suitable strength.

(3) Suitably strong benches upon which sand bags have been placed to bear against the wing spars.

(4) Adjustable height steel stands to bear against such units of the primary structures of the airplanes as are capable of supporting the airplane weight. When this method is employed, stands will contact the airplane at a point forward of the normal center of gravity, or sufficient sandbags will be tied to the airplane tail to bring the center of gravity back to point of support.

(5) Engine Mount.- The nose of the airplane may be jacked by removing the lower half of the cowlings and inserting the jack points in the engine mount lift rings. Jack, Specification No. 40415, with one extension per leg should be used.

NOTE: The jacking of the airplane by the engine lift rings is to be used only on the airplanes not having provisions for the wing jacks.

4. Towing.

A towing ring is provided at the lower end of each wheel fork of the main landing gear for towing the airplane forward.

The airplane may be towed in an aft direction by attaching towing gear to the catapult hold-back shackle. See fig. 1-VII for location of this fitting. Do not mistake the arresting gear roller for the holdback shackle. The shackle is just forward of the roller.

CAUTION: Be sure that the tail wheel swivel is unlocked before towing the airplane (in any direction).

5. Parking.

A control parking harness, S84-89-538-17, is furnished with each A-25A Airplane. To install the parking harness, proceed as follows:

Push the control stick forward of "NEUTRAL" and hold.

Place the center spliced portion of the parking harness behind the stick and attach the hooks of the two short cables to holes in the respective pedal adjusting sectors.

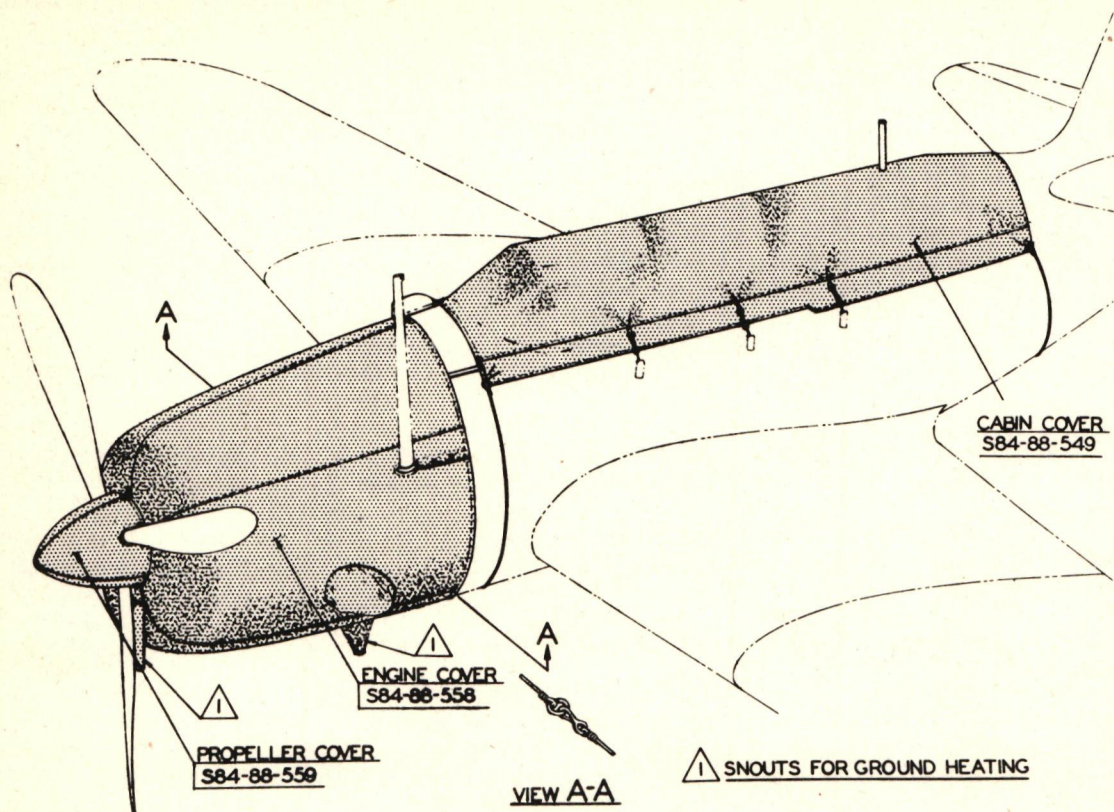


Figure 5-VII - Engine and Cabin Covers

Position the harness on the stick and attach the hooks of the long cables to the respective holes at the forward corners of the pilot's seat.

Raise the seat to tighten the parking harness.

6. Mooring.

A retractable tie-down ring is provided in the lower surface of each outboard end of the center panel forward of the front beam and near the wing fold line.

The towing rings on the landing gear forks may also be used for mooring.

7. Covers.

a. Cockpit Enclosure.- A single waterproof cover assembly, S84-88-549, which will cover the entire cockpit enclosure including the windshield, is provided. Shock cord lines which pass around the fuselage are provided at each end of the cover assembly. Snap hooks are provided on these front and rear shock cords to secure the ends at installation. Three additional shock cord and hook assemblies are located on each side so that the hooks may be installed in the hand-grip openings of the fuselage.

One cover assembly, S84-88-549, is furnished with each A-25A Airplane.

b. Engine and Propeller.- The waterproof engine cover assembly, S84-88-558, comprises two principal units, one for the propeller and one for the engine cowling.

The propeller cover is attached at one point to the engine cover. Straps with snap fasteners are provided for securing the covers around the root of each blade.

The engine cover is equipped with snap fasteners along the bottom center line. Shock cord is sewed into the aft periphery of the cover and is provided with a snap hook at the bottom. At each side of the top rear ring, a strap extends aft to attach by means of a snap fastener to the forward portion of the cabin cover.

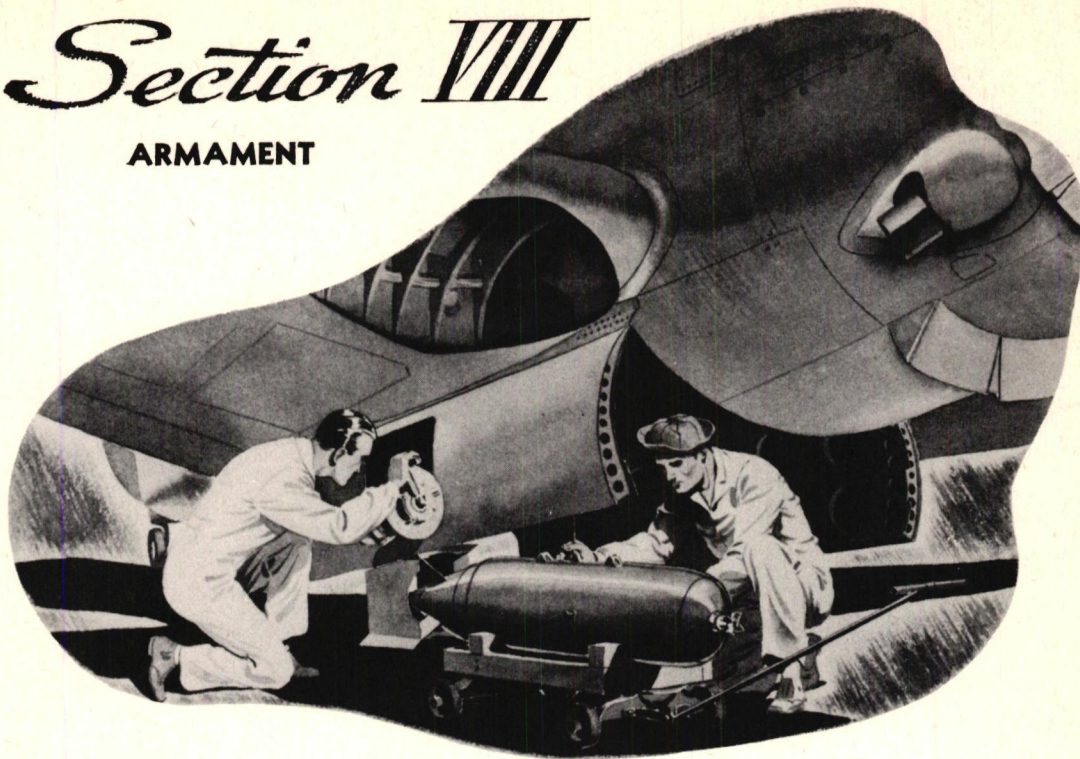
8. Leveling Lugs.

Three leveling lugs are provided on the sills of the front cockpit at station 35 and station 52. An ordinary spirit level may be used on these sills.



Section VIII

ARMAMENT



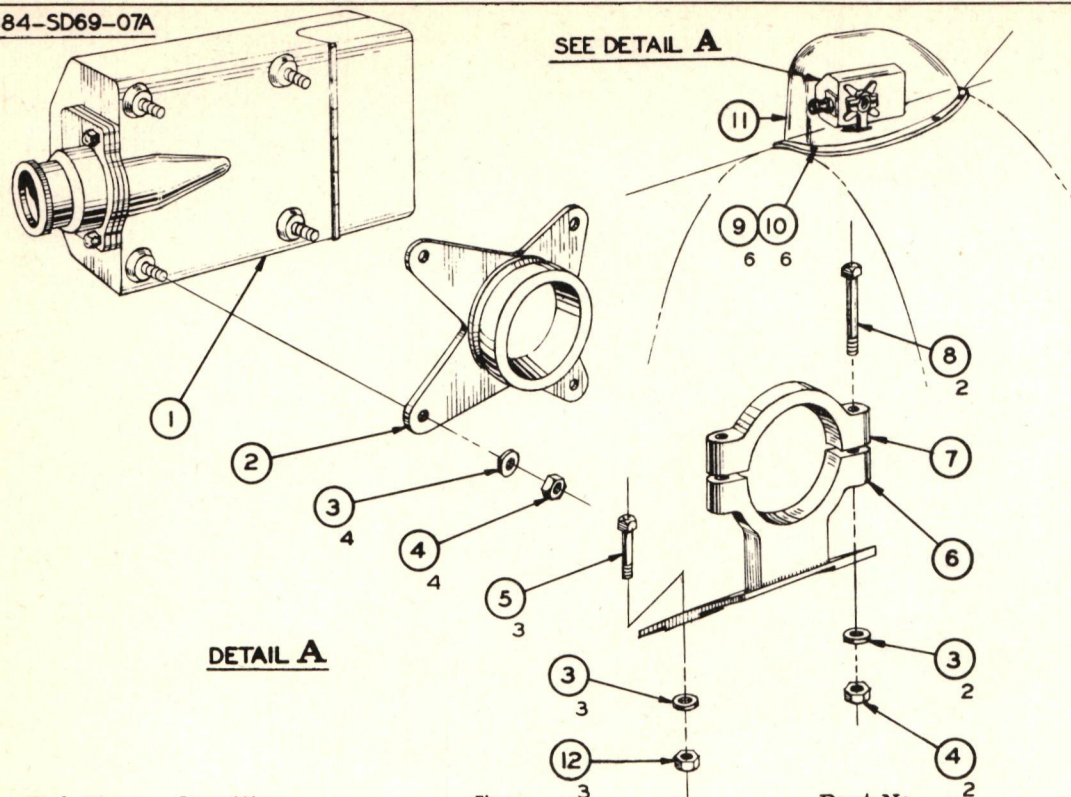
1. General.

The armament equipment of the A-25A Airplane consists of four fixed machine guns in the wings, a flexible machine gun in the turret, and a bomb bay designed to carry either bombs, an auxiliary fuel tank, or a smoke tank. Provision is also made for carrying wing bombs. Gun-fire protection (armor plate) is provided for the pilot, gunner, and vital areas of the airplane. Gun cameras are installed to operate with both fixed guns and flexible gun.

a. Wing Guns.- The A-25A Airplane is equipped with two caliber .50 machine guns, type M-2, in each center panel. The guns are located just outside the propeller arc and are equipped with seamless steel blast tubes extending from the gun barrels through the leading edge of the wings. The machine guns are of the fixed type, provided with an electric solenoid for firing and a hydraulic charger for initially charging the gun and ejecting dud shells.

The recoil buffer is of the horizontal type and the gun utilizes the force of recoil to reload and fire the gun automatically, as long as ammunition is supplied and the solenoid keeps the trigger pressed. The ammunition is supplied to both inboard and outboard guns, through a series of linked chutes from four ammunition boxes, two serving each gun. Each gun is supplied with 433 rounds of ammunition. Illuminated gun sight MK VIII, located in the front cockpit is used in sighting the wing guns. A gun camera type N-4-RO.294389 is mounted on the fuselage just ahead of the windshield. The camera is actuated electrically, being automatically controlled by circuits including a switch mounted on the armament switch panel, the thumb button release switch, and the trigger-type gun firing switch on control stick. The first switch serves to connect the camera in circuit with either of the other two switches, so that when camera is in the circuit with the trigger switch, it will operate each time the switch is closed to fire the wing guns.

b. Installation.- The wing guns are inserted through the landing gear cutouts in the center panel. The guns are staggered for feed, the outboard gun being forward of the inboard gun. Inboard gun must be installed first and removed last. The distance between their center lines is 7.13 inches. The guns are mounted on two supports between station 102 and station



Ref. No.	Quantity	Item	Part No.
1	1	G.S.A.P. Camera	Type N-4-B.O.294389
2	1	Adapter	S84-69-916
3	9	Washer	AN960-D10
4	6	Nut	NAF 1137-1032
5	3	Bolt	AN3-6A
6	1	Bracket	S84-59-1011-1
7	1	Cap	S84-59-1011-2
8	2	Bolt	AN502-10-26
9	6	Dzus Fastener	S84-69-623
10	6	Snap Ring	S82-64-190-.043-.222
11	1	Fairing	S84-69-622
12	3	Nut	AAF365-1032

Figure 1-VIII - Fixed Gun Camera Installation

122. The guns are attached to the front support S84-69-511 by a gun trunnion bracket S84-69-513. Vertical and lateral adjustments of the gun can be made at support S84-69-512. Refer to fig. 2-VIII for fixed gun installation. An access door, located directly below the wing guns, can be removed to facilitate servicing, removal, and installation of the guns. Removal of the door is accomplished by unfastening seventeen Dzus fasteners. The gun action may be withdrawn by removal of the back plate of the gun through the access door; then, having the flaps open, the gun action is removed through the flap beam openings. The guns may then be removed by disconnecting the electrical connection to each solenoid, removing the gun charger by removing two wing nuts (do not disconnect hydraulic lines), taking the blast tube off the barrel jacket, and finally disconnecting the guns from the supports. The chute for the empty cartridges of the outboard gun is removed with the access door, and the chute for the inboard gun is removed, prior to removal of the guns, by pulling out two locking pins in hinge fittings. The feed chutes are attached to the ammunition boxes and lead to the gun feedways. The vertical and lateral positions of each gun are adjusted at the rear support as described below. Vertical and lateral adjustments are accomplished by means of a post assembly S84-69-514. The post S84-69-514-1 has a threaded stud which fits in a bushing S84-69-515, inserted in the rear support. The post is locked in any desired vertical position by a nut 32A4449 on the post turning down on top

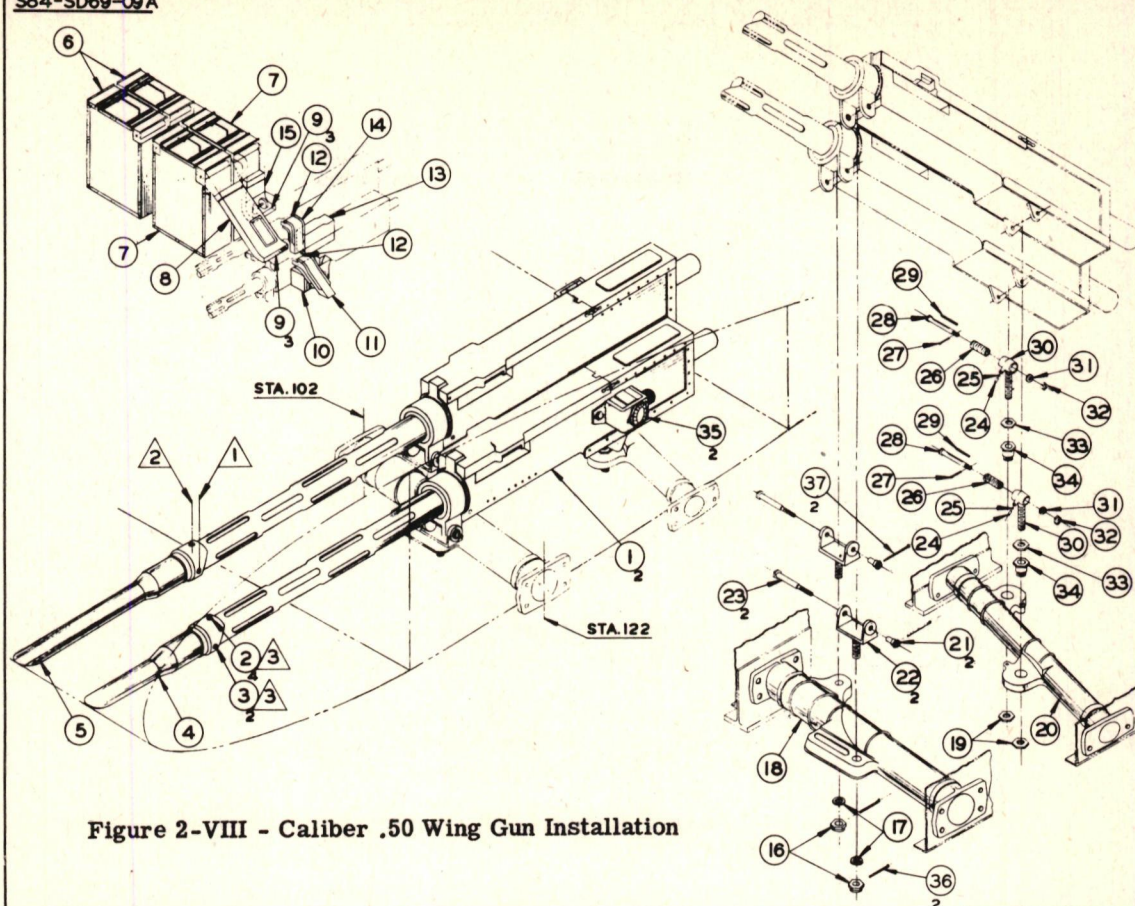


Figure 2-VIII - Caliber .50 Wing Gun Installation

Ref. No.	Quantity	Item	Part No.
1	2	Caliber .50 Machine Gun	M2B.O. 297034
2	4	Stud	S84-59-828
3	2	Stud	S84-59-583
4	1	Blast Tube	S84-59-903-3
5	1	Blast Tube	S84-59-903-4
6	2L	Ammunition Box	S84-69-519
7	2L	Ammunition Box	S84-69-518
8	1L	Feed Chute	S84-69-531
9	6	Block	S84-69-928
10	1L	Case Chute	S84-69-542
11	1L	Link Chute	S84-69-563
12	2	Block	S84-69-521
13	1L	Case Chute	S84-69-569
14	1L	Link Chute	S84-69-548
15	1L	Feed Chute	S84-69-522
16	2	Nut	AN310-12
17	2	Washer	AN960-1216
18	1L	Support	S84-69-511
19	2	Nut	S84-69-516
20	1L	Support	S84-69-512
21	2	Sleeve Nut	AC04-8862
22	2	Bracket	S84-69-513
23	2	Bolt	048861
24	2	Screw	038039
25	2	Button	068679
26	2	Sleeve	046686
27	2	Cotter Pin	AN380-3-3

PARTS LIST - CALIBER .50 WING GUN INSTALLATION

28	2	Bolt	04-6687
29	2	Key	04-6681
30	2	Post	S84-69-514-1
31	2	Washer	AN960-716
32	2	Nut	AN310-7
33	2	Nut	32A4449
34	2	Bushing	S84-59-975
35	2	Solenoid	B.O.300186 MK.V-I
36	2	Cotter Pin	AN380-5-6
37	2	Cotter Pin	AN380-3-4

NOTES:

- 1 Center line of stud S84-69-583 when blast tube is fastened to barrel jacket having round holes.
- 2 Center line of stud S84-69-583 when blast tube is fastened to barrel jacket having elongated holes.
- 3 Lock wire required at points noted.
4. Slot in blast tube stud adjusted perpendicular to center line of gun barrel before securing with lock wire. Stud not to be tightened excessively.
5. To withdraw gun action: Remove back plate of gun through gun access door and withdraw gun action through flap beam openings.
Note - Flaps must be open. To insert gun action, reverse procedure.
6. Solenoid may be interchanged with gun charger on inboard gun depending upon convenience for installation.

of the bushing. The bushing is secured to the rear support by a nut S84-69-516, which is held in place by a locking plate S84-69-517. Lateral adjustment is accomplished by means of the same post S84-69-514-1. The post has a hollow cylinder at the head of the stud at 90 degrees to the axis of the stud. The cylinder portion has inside threads which permit the post to be moved laterally on a threaded sleeve 046686. The sleeve is held in place by a key 046681 fitting in slots in the bolt 046687 and sleeve. The bolt 046687 attaches the post assembly to the gun. To make lateral adjustments, the bolt 046687 must be loosened and the post adjusted to the desired position on the sleeve. The guns are adjusted according to the instructions shown on the Boresighting Diagram, fig. 4-VIII. Provision is made for adjusting gun to any intermediate position between that for convergence at 250 yards and the position parallel to plane of symmetry of the airplane. The ammunition boxes S84-69-518 and S84-69-519 are located in tandem, laterally for each gun. The boxes are installed in a vertical position in a wing cutout between stainless steel slides mounted between the front and rear beams. The boxes are located between stations 73.75 and 87, and stations 87 and 102 respectively. The boxes are linked together at the top by a chute permitting the ammunition "belt" to be a single belt. A feed chute S84-69-530 extends from the top of box No. 1 to feed chute S84-69-531 which leads to the gun. A link chute S84-69-563 provides a means for ejecting the disassembled metallic links of the belt, while empty cartridges are ejected through the case chute. The opening, for the ejection of shells, is in the bottom of the center panel slightly outboard of the gun. The above description of the feed chutes is for the outboard gun; the inboard gun will be similar except for the length of the feed chute and case chute.

2. Operation.

a. Loading the Ammunition Boxes.- The ammunition boxes are removed from the airplane for loading. Ammunition box access door located in the top wing surface is swung open by loosening 14 Dzus fasteners. The door hinges about the forward edge. The ammunition boxes are lifted out of the wing by means of the handles on top of the box. The boxes are opened by pulling out two locking pins in each door which are on top of the

S84-SD69-05A

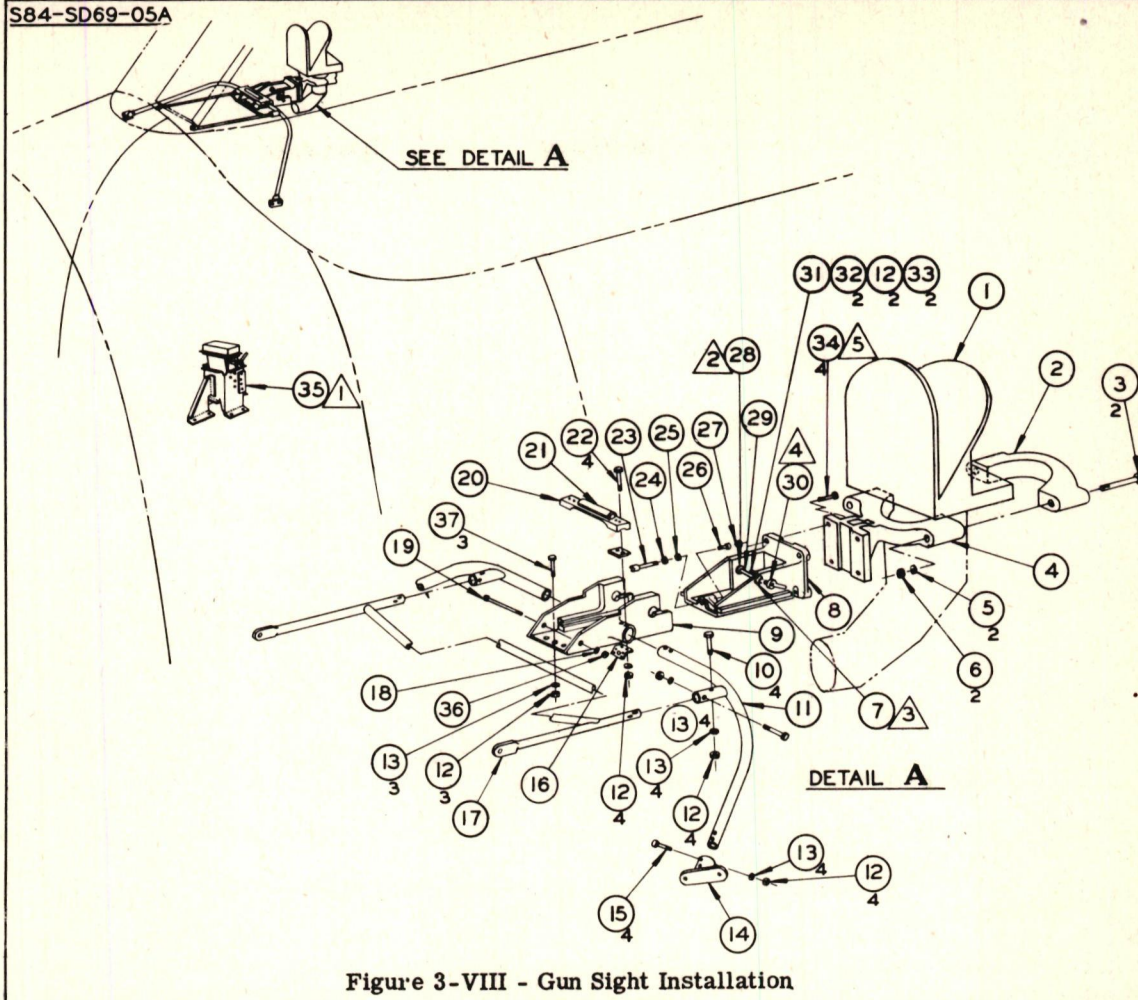


Figure 3-VIII - Gun Sight Installation

PARTS LIST

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Gun Sight	MK VIII
2	1	Bracket	S84-59-656-2
3	2	Bolts	AN5-23A
4	1	Bracket	S84-59-656-1
5	2	Washer	AN960-D-516
6	2	Nut	NAF 1137-518
7	1	Stop	S84-69-593
8	1	Support	S84-59-544
9	1	Support	S84-59-543-1
10	4	Bolt	AN3-10A
11	1L & 1R	Support Assembly	S84-59-1013 *
12	17	Nut	NAF 1137-1032
13	15	Washer	AN960-D10
14	1L & 1R	Socket	S84-59-1012 **
15	4	Bolt	AN3-11A
16	1	Bracket	S84-59-939
17	1	Tube Assembly	S84-59-927
18	1	Washer	AN960-C10L
19	1	Bolt	AN3-35
20	1	Strap	S84-59-928
21	1	Pad	S84-69-503-3
22	4	Bolt	AN3-20A

PARTS LIST - GUN SIGHT INSTALLATION

23	1	Bolt	S84-69-992
24	1	Nut	AN316-C5R
25	1	Washer	AN960-C516L
26	1	Adapter	S84-69-991
27	1	Nut	AN345-C10
28	1	Collar	S84-69-592
29	1	Shaft	S84-59-541
30	1	Handle	S84-69-594
31	1	Spring	S84-59-542
32	2	Screw	AN510-C10-16
33	2	Washer	AN960-C10
34	4	Screw	AN502-516-12
35	1	Sight Stowage Assembly	S84-59-900
36	1	Nut	AC365-1032
37	3	Bolt	AN3-9A

* S84-59-1013 support used on airplane No. 41-18824 and up. Airplanes No. 41-18774 through 41-18823, use S84-59-926 support.

** S84-59-1012 socket used on airplane No. 41-18824 and up. Airplanes No. 41-18774 through 41-18823, use S84-59-583 socket.

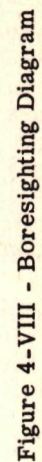
NOTES:

- ① When sight is stowed, crash pad takes its place on sight support. Crash pad is shown in stowed position on drawing.
- ② Secure with 1060-D-O-13 pin. Peen ends.
- ③ Secure with 1060-D-O-17 pin. Peen ends. Stop pin in S84-59-544 is 1060-D-1-9.
- ④ Secure with 1060-D-1-13 pin. Peen ends.
- ⑤ Lock wire.

boxes. The cartridge belt is fed into each ammunition box and arranged in orderly layers. The boxes are closed and placed back in their proper positions. The ammunition belt from the inboard box is connected to the No. 1 box through the connecting chute. The belt from the No. 1 gun is then drawn to the gun feedway. Rollers are provided for belt to travel over when it leaves and enters the boxes. Rated capacity of No. 1 box is 225 rounds, and No. 2 box is 208 rounds.

3. Sighting.

The pilot, in sighting the fixed wing guns, uses illuminated gun sight MKVIII, mounted on the fixed support assembly, as shown on fig. 3-VIII. The pilot's eye in normal flying position is 30 inches from the top of the seat cushion. In the gunning position, the pilot must move forward until his eye is 0.50 inch higher than normal and eight inches aft of the center line of the sight. The cone of the gun sight vision, in the gunning position, is 26 degrees 25 minutes. The H R L is 8 degrees 30 minutes above the lowest vision line and 17 degrees 55 minutes below the highest vision line. A socket is provided, on the base of the gun sight, for the electric plug. The switch and rheostat to operate the light in the gun sight are located on the armament switch panel. The bulb in the gun sight has two filaments, one of which receives current when the gun sight switch is in the "ON" position. The other filament may be used by setting the switch on "ALTERNATE ON" position. The crash pad and gun sight are designed to fit into either the stowage bracket on the floor or into the fixed support. When the sight is stowed, the crash pad takes its place on the sight support. The sight and wing guns are adjusted so that they converge at a point 250 yards ahead of the airplane on an extended center line.



4. Charging.

The wing guns are charged hydraulically. The Bendix hydraulic gun charger cylinder and hydraulic gun charger control valve provide means to charge the wing guns from the control valve handle in the cockpit. The control valve handles for the left and right wing guns are located on the left side and right side of the auxiliary instrument panel, respectively. The purpose of the charger is to initially charge the gun and to remove defective shells. When the control valve handle is in the "SAFE" position, the pointed end is upward. Rotating the handle clockwise against the stop brings it in the firing position. Charging is accomplished by depressing the plunger. At the end of the charging stroke, the pressure builds up approaching system pressure and, at approximately 750 pounds per square inch the plunger automatically releases; returns to original position; and allows the fluid in the cylinder to exhaust through the return line. A safety feature is incorporated in the charging system, whereby it is impossible to fire the gun should the firing switch be inadvertently closed. To hold the gun safe, the control valve handle is turned counterclockwise to the "SAFE" position and then depressed. The gun will then be "SAFE" until the handle is rotated clockwise to the firing position.

CAUTION: Minimum operating pressure to insure automatic release of valve is 800 pounds per square inch.

5. Firing.

The guns are fired electrically by a trigger mounted on the control stick, and the use of solenoids B.O.300186 MKV-1. The electrical switches on the armament switch box permit the guns to be fired in pairs or salvo. The armament switch box is located on the lower left side of the pilot's cockpit. The solenoids are mounted outside with respect to both guns and are energized by pressing the trigger switch on the forward side of the control stick. Protective breaker switches are placed on the armament switch box for the inboard and outboard guns. These breakers should be open when the circuit that they control is not in use. The guns normally continue to fire as long as the firing switch is depressed, providing ammunition is supplied.

6. Maintenance.

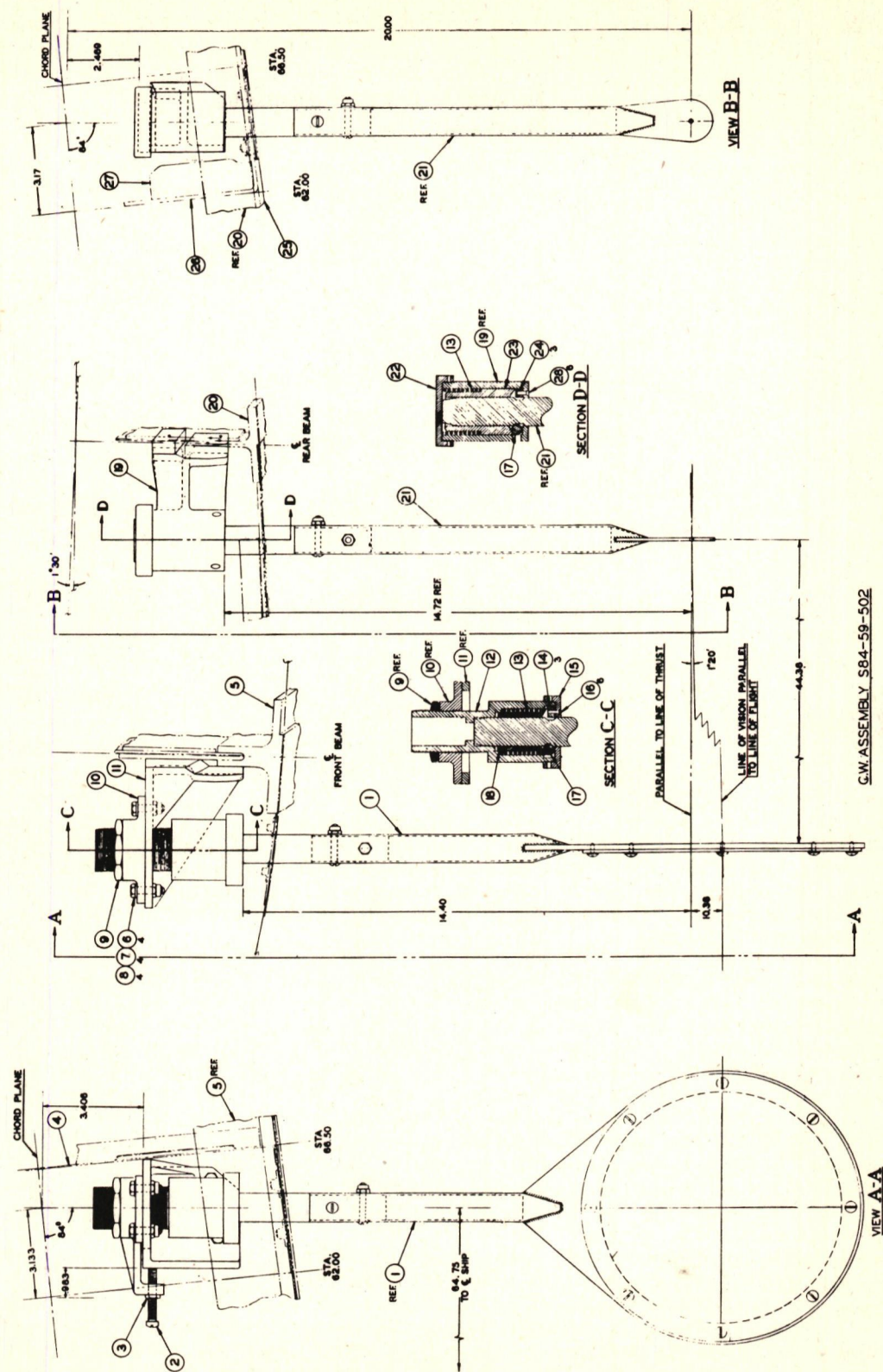
a. General.- The servicing and maintenance of the machine guns is normally a function of armament personnel. To repair a damaged gun, it is removed from the airplane as described in the section on Installation and then taken to the armament repair shop for service. Make certain that the gun is unloaded after landing and also before proceeding to remove gun from the wing. Do not fire more than 50 rounds on the ground without cooling the barrel. When firing from an airplane, the current of air, developed by the speed of the plane acts to some extent as a cooling agency. The slot in the blast tube stud is adjusted perpendicular to the center line of the gun barrel before securing with lock wire.

The stud is not to be tightened excessively. In fastening the blast tube to barrel jacket having round holes, stud S84-69-583 is screwed into the collar with large diameter end on the inside. Reverse the stud when fastening to jacket with elongated holes. Adjust blast tubes to extend 0.12 inch beyond sliding plates in leading edge. The sliding plates are adjusted by loosening screws and moving up or down to insure minimum opening at blast tube intersection with wing skin.

If airplanes are delivered without the machine guns installed, sealing tape is applied over gun openings. Boresighting diagram S84-SD69-04 is used to adjust guns for relationship to sight and camera. Removal of a gun will not affect boresighting if same gun goes back on same mount.

b. Boresighting.- The line of action of the wing guns, gun camera, and gun sight converge 250 yards ahead of the airplane on an extended center line. As checking a point 250 yards from the airplane would be difficult and inaccurate, a screen is placed 30 yards from the airplane and in a position to intercept the lines of action of the various circuits. The dimensions for these lines, as seen on the screen are shown on the boresighting figure . The horizontal and vertical boresight template lines on this screen are used to set the airplane in the correct position for checking these points. The boresighting screen is set up perpendicular to the line of flight, and the horizontal datum lines of the screen are adjusted to be parallel to

S84-SD69-06



CW ASSEMBLY S84-59-502

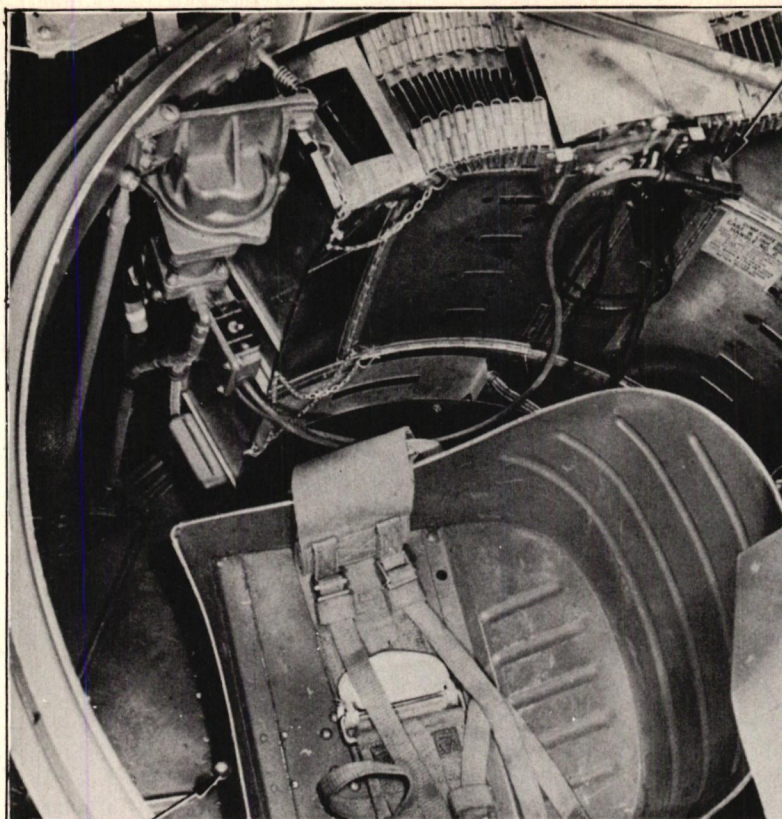
Figure 5-VIII - Boresight Fixtures Installation

PARTS LIST - BORESIGHT FIXTURES INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1		Boresight Bracket Stem Assembly (Ref.)	S84-59-730 *
2	1	Screw	AN502-416-30
3	1	Nut	AN316-4R
4		Sta. 66.50 Center Panel Nose Rib (Ref.)	S84-04-566
5		Center Panel Main Beam Assembly (Ref.)	S84-04-504
6	4	Bolt	AN4-10A
7	4	Nut	AAF365-428
8	4	Washer	AN960-D416
9	1	Nut	S84-59-791
10	1	Guide	S84-59-737
11		Support (Front) (Ref.)	S84-59-769
12	1	Bushing (Front)	S84-59-736
13	2	Spring	S84-59-796
14	3	Retainer (Front)	S84-59-731
15	1	Cap (Front)	S84-59-792
16	6	Screw	AN505D6-6
17	6	3/8 Diameter Steel Ball	Nice Ball Bearing Co., Philadelphia, Pa.
18	1	Sleeve (Front)	S84-59-734
19		Support (Rear) (Ref.)	S84-59-766
20		Center Panel Rear Beam (Ref.)	S84-04-505
21		Sight Assembly (Ref.)	S84-59-795 *
22	1	Cap (Rear)	S84-59-794
23	1	Sleeve (Rear)	S84-59-768
24	3	Retainer (Rear)	S84-59-738
25		Wing Tank Door Assembly (Ref.)	S84-04-762
26		Sta. 62.00 Center Panel Rib (Ref.)	S84-04-560
27		Rib Sta. 62.00 Rear Lower Corner (Ref.)	S84-04-725
28	6	Screw	AN515D6-6

* One each of S84-59-730 and S84-59-795 are to be supplied with every sixth airplane. S84-59-730 assembly, S84-59-795 assembly and S84-59-825 wrench are carried in S84-59-829 box and are called out on S84-88-504.

the ground line. Two boresight fixtures S84-59-730 stem assembly and S84-59-795 sight assembly are stowed in every sixth airplane, as well as a wrench S84-59-829. These boresight fixtures, a front and rear, are used for placing the airplane in the correct attitude for checking the points of convergence. The fixtures are installed in the left center panel at station 64.75. The front fixture, S84-59-730 stem assembly, has a plexiglass center marked with cross hairs. It is inserted through an access door into an adjustable bracket, which is mounted forward of the front beam. The adjustable bracket consists of a bushing which threads into a support and is locked in the proper vertical position by a nut. The rear boresight bracket is non-adjustable and is located forward of the rear beam. Details of the boresight brackets and fixture sockets are shown on fig. 5-VIII. To install the boresight fixture, it is necessary only to insert each fixture into the proper socket until it locks into position by means of the spring-loaded balls. (The boresight fixtures are properly adjusted at the factory or overhaul base by establishing the airplane in an attitude of flight, by means of a leveling device. Once boresighting fixtures are set in the shop they should be used without change (except by proper engineering authority) in conjunction with the boresighting screen, to place the airplane in proper flight position. The boresight screen is adjusted so that the boresight bull's-eye is on the same level as the aperture in rear boresight bracket. The front boresight is then adjusted vertically and horizontally to bring cross hairs into alignment with bull's-eye and the clamping bolts tightened securely. The airplane is established in proper attitude by raising the tail and moving it laterally until the line of sight of the boresight fixtures falls on the bore-



1. Dump Chute Control
2. Seat Rotation Valve
3. Turret Lock
4. Turret Control Stick
5. Seat Strut By-Pass Valve
6. Armor Plate
7. Emergency By-Pass Valve
8. Trigger Switch
9. Turret Switch Panel

S84-69-12

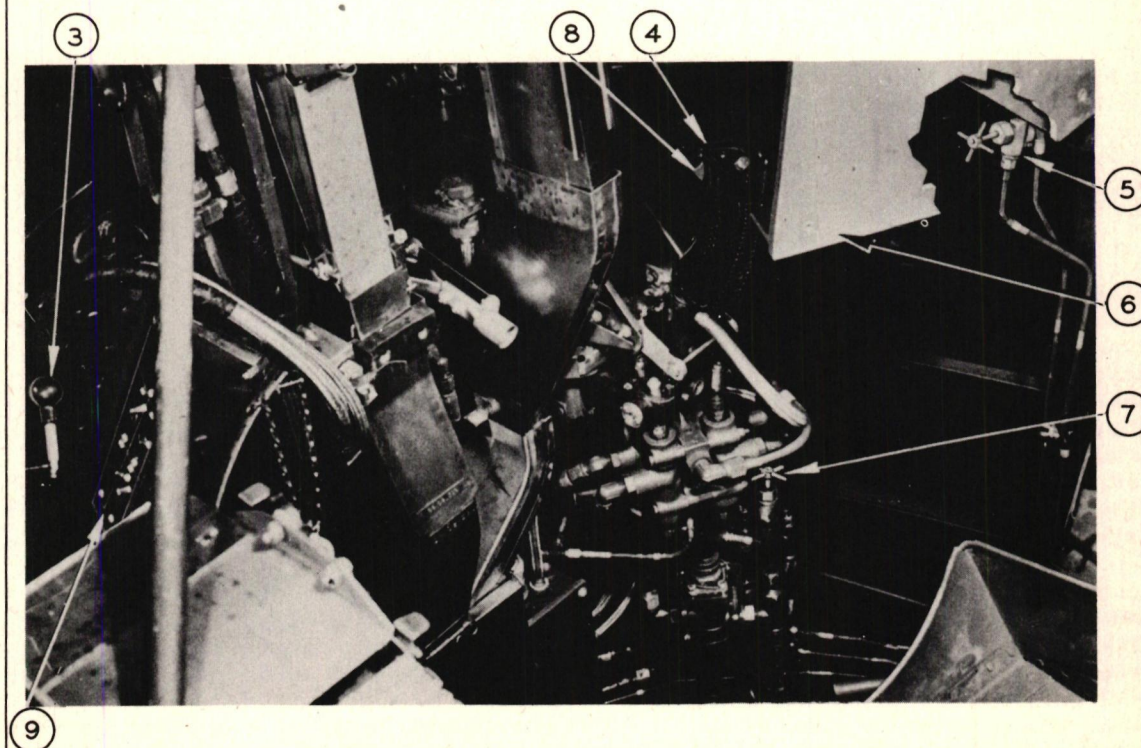


Figure 6-VIII - Turret Installation

sight bull's-eye on the screen. The attitude of flight of 1 degree 21 minutes is established under the conditions of estimated full speed of the airplane at critical attitude and in the primary combat conditionless one-half fuel load. This condition includes calculated weight empty, useful load including two 500-pound bombs, four wing guns, 800 rounds of ammunition, 105 U. S. gallons (86 Imperial gallons) fuel and 12 U. S. gallons (10 Imperial gallons) oil, total gross weight being 12,911 pounds. When the airplane has been established in the proper attitude, the wing guns, gunsight, and gun camera are aligned with their respective points on the screen by the use of boresight tools. The boresight tool for the wing guns is an optical instrument which fits in the barrel of the gun.

7. Flexible Gun Turret.

a. General.- The A-25A Airplane is equipped with a flexible caliber .50 Browning aircraft machine gun type M-2. The gun is located in the hydraulically controlled gun turret which is installed in the aft cockpit. The machine gun has a left-hand feed and is equipped with the following accessories:

(1) A Bendix hydraulic gun charger No. 76862 located on the right side of the gun, on airplanes No. 41-18774 through 41-18783.

(2) A gun camera installation S84-69-914 mounted on top the gun aft of the feedway.

(3) A shoulder guard S84-69-800 aft of the end plate for the protection of the gunner.

(4) An electric solenoid MK MOD. V-1 B.O.300186 located on the left side.

The gun is mounted on mount assembly S84-59-503 located on the gun casting which ties into the horizontal ring. The adapter S84-69-668 is used to absorb recoil of the gun. The gun is mounted on a 1-1/2 inch diameter shaft, which is directly connected to the vertical gear box through a set of gear reductions to the elevating hydraulic motor. The gun installation is on the center line of the turret and at the edge of the rotating ring. The gun moves in synchronization with illuminated sight MK IX B.O.281777, through an arc of 85 degrees up and 70 degrees down. The turret will rotate unrestricted through 360 degrees. The ammunition box is located on the left-hand side of the gunner when in the gunning position. It has a capacity of 470 rounds. The ammunition is fed up through a flexible chute and a power feed directly into the gun. An ammunition booster is located on top of the ammunition box between the two flexible chutes connecting the ammunition box to the gun. The shells and links are ejected from the gun down through the case and link chutes into the retriever. An access door is located in the retriever in order to move cases and links to rear of retriever box as the box begins to fill up. An ammunition dump chute is located at the bottom of the retriever for dumping cases and links out through the bottom of the fuselage.

A gun fire interrupter is provided to eliminate the possibility of the gunner firing into any part of the airplane. The gun fire interrupter is controlled by a micro-switch in the swivel assembly. A bell crank at the top of the swivel assembly is attached to the gun at one end and to a shaft at the other end, which extends from the top of the swivel assembly down to the micro switch at the base of the assembly. This bell crank transmits both the revolving and up and down movements of the gun to the shaft, which in turn transmits these movements to the micro switch. The micro switch revolves about the axis of the shaft and is in contact with the inner housing profile. A pre-cut and predetermined cam is installed on the inner housing profile. This cam is designed so that, when any part of the airplane comes within the line of fire of the flexible gun, the firing current is broken by the micro-switch and the gun is rendered inoperative until it moves beyond the airplane contour again.

An overpower mechanism is installed in the hydraulic system to prevent the gun from hitting the fuselage. This is accomplished by means of a hydraulic valve controlled by a cam on the turret ring. The gun is also prevented from elevating beyond the 85 degree "UP" position by use of two micro-switches. One switch is located to the left of the gun on the channel running from the gun mount ring to the floor. As the gun is elevated to the 85 degree "UP" position, the gun butt opens the electrical circuit which closes the magnetic solenoid hydraulic circuit; thus stopping the gun. The other micro switch is located just forward of the main control valve handle. In order to bring the gun down, it is necessary to move the control stick forward, which automatically closes the micro-switch and opens the magnetic solenoid. As the

gun muzzle moves down, the first micro-switch recloses and restores the system to normal operating condition.

b. Installation.- The turret is assembled as a unit, before installation in the fuselage. The hoisting sling S84-74-501 is attached to four eyebolts spaced on the turret ring for installing in fuselage. Numbers are stamped on four terminals of the hoist, and they should be matched with the numbers stamped on the eyebolts. The turret is not balanced; therefore any change in the attaching points of the sling results in difficulty in insertion of the turret assembly into aft cockpit. Raise the turret over the fuselage and lower it into the aft cockpit. Guide the swivel assembly down through the hole in the fuselage floor. Two access doors are provided on the under side of the fuselage between station 158 and station 176 to facilitate guiding the swivel down, to provide easy access to the hydraulic lines and electrical gun-firing conduit, and for completing all connections after the turret is installed in the fuselage. The turret is attached to the upper rear longerons, the bulkhead at station 158, and to the aft cockpit floor by bolts. Removal of the gun from the adapter consists of removing one bolt forward of the gun shaft and one bolt aft of the gun mount shaft; care taken that the spacers are put back in the proper position when assembling the gun.

c. Operation and Adjustments.- All movements of the turret are controlled by the gunner by means of a "stick" actuating a Vickers control valve. This same "stick" also houses a gun firing switch and a push button switch which actuates a hydraulic solenoid that controls the flow of hydraulic fluid. The turret is made to rotate clockwise by moving the control "stick" to the right, and counterclockwise by moving the "stick" to the left. The "stick" is moved away from the gunner to depress gun and toward the gunner to elevate gun. The maximum speed of gun elevation and turret rotation is 40 degrees per second. The illuminated gun sight MK IX BO 281777 is synchronized with the operation of the gun by means of a mechanical linkage and gear system. This linkage and gear system should require no adjustment; however, backlash may be taken out of the gun sight mechanism by adjusting the eccentric bushings. The gun sight is adjustable laterally or vertically by the bolts on clamp S84-59-663, shifting the gun sight into the desired position, then tightening the two bolts. Minor vertical adjustments may be made by loosening the two (1137-10) nuts on the right side of the sight shield (a special wrench is provided with each sight), rotating cam (adjusting lever is on the forward left side of the shield) until the desired position is attained, then tightening the two (1137-10) nuts. The maximum angle of sighted fire is 55 degrees due to interference of turret ring with line of sight. The switch and rheostat are located in the armament switch box. The rheostat controls brilliancy of the light in the gun sight. Since the gun will elevate to 85 degrees and depress to 70 degrees, it is necessary that the seat move up and down so that the gunner may conveniently use the gun sight at all times. Movement is transmitted to the seat by a hydraulically-operated strut attached to the seat carriage. The strut motion is synchronized to the gun operation. As the gun is elevated or depressed, the piston in the gun strut moves up or down accordingly, and the seat rises or falls. The seat, when in flight position, is at a fixed level. There are two methods of moving the seat:

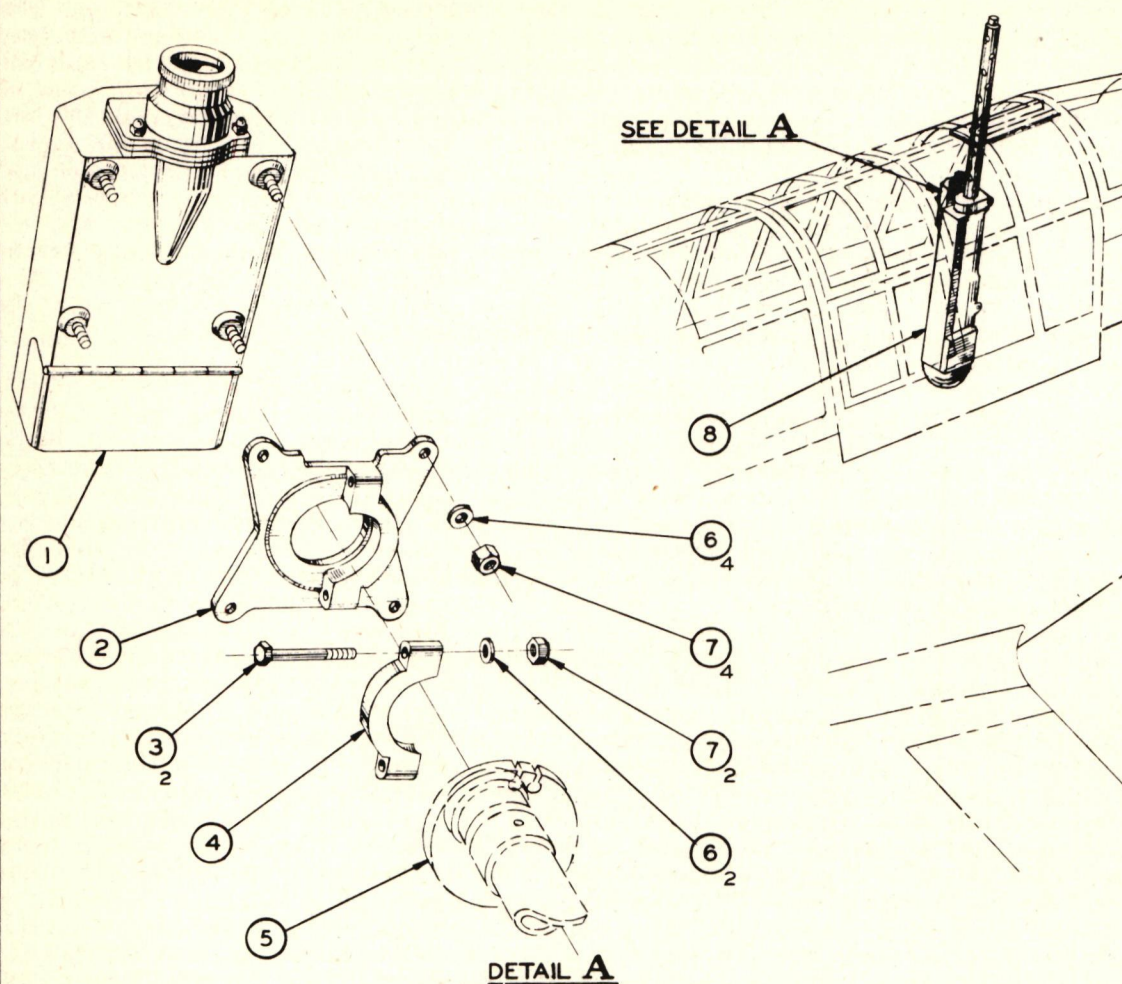
(1) The seat automatically moves into gunning position, when the gun is depressed from its stowed position of 85 degrees elevation.

(2) The seat may also be lowered by manual operation of a lever which is located on the seat carriage.

When the seat is in gunning position, adjustments are provided for fixing the seat (take into consideration the necessary plus or minus 2-inch adjustment required for variations in man's height) at any one of three levels, which adjustments are made by means of a lever, located on the seat carriage. (This lever is also used to lower the seat into gunning position.)

Refer to section IX of the Handbook for seat adjusting and synchronizing procedure.

With a seat in its highest gunning position and the gun at its lowest position, the gunner should be able to sight the gun from his normal sitting position. The seat may be turned, manually, from the forward position by raising the handle located beneath the gunner's seat. On airplanes No. 41-18774 through 41-18783, the gun is charged by a control valve located to the right of the main control "stick." In the safe position, the pointed end of the handle is upward. Rotating the handles clockwise and depressing plunger charges the gun. The gun is fired by the electric solenoid which is controlled by the firing trigger located on the forward side of the main control handle. The gun continues firing as long as the trigger switch is de-



PARTS LIST - FLEXIBLE GUN CAMERA INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	G.S.A.P. Gun Camera Type M-4	B.O. 294389
2	1	Mount	S84-685-1047-1
3	2	Bolt	AN3-13A
4	1	Cap	S84-685-1047-2
5		Pulley (Ref.)	S84-685-1048
6	6	Washer	AN-960-D10
7	6	Nut	AAF365-1032
8		Browning Aircraft Machine Gun Caliber .50 (Ref.)	S84-SD60-01

Figure 7-VIII - Flexible Gun Camera Installation

pressed, providing ammunition is available to the gun. The ammunition booster is operated electrically and connected to the firing trigger. In order to fire the gun, the button on top of the main control handle must be depressed. This is the "Dead Man's Control," both the hydraulic flow and the firing circuit being interrupted when button is not depressed. The gun camera can be operated simultaneously with the firing of the flexible gun. In order for the gun camera to operate with the gun, a switch located in the turret switch box must be placed in the "ON" position. The center line of the camera lens is .06 inch to the left of the center line of the gun. The vertical lens field is 12 degrees 20 minutes and the horizontal lens field 16 degrees 16 minutes thereby including the target.

d. Ammunition Loading.- The ammunition is loaded through the forward end of the ammunition box. It is first loaded into the aft compartment and from there into the forward compartment. Next, the ammunition is fed through a power feed up into a flexible chute and feedway, which guides the linked cartridges into the gun.

NOTE: See loading diagram attached to the ammunition box.

Five hundred rounds of ammunition are provided. The links and empty cartridges are ejected through chutes into the lower section of the ammunition box.

Empty shells and links may be dumped through an access door in the bottom of the fuselage, when the gun and turret are in the stowed position. Dumping is accomplished by release of a lever. These operations should only be carried out during level flight or on the ground.

WARNING: Be sure that links and empty shells are removed from the ammunition box before reloading.

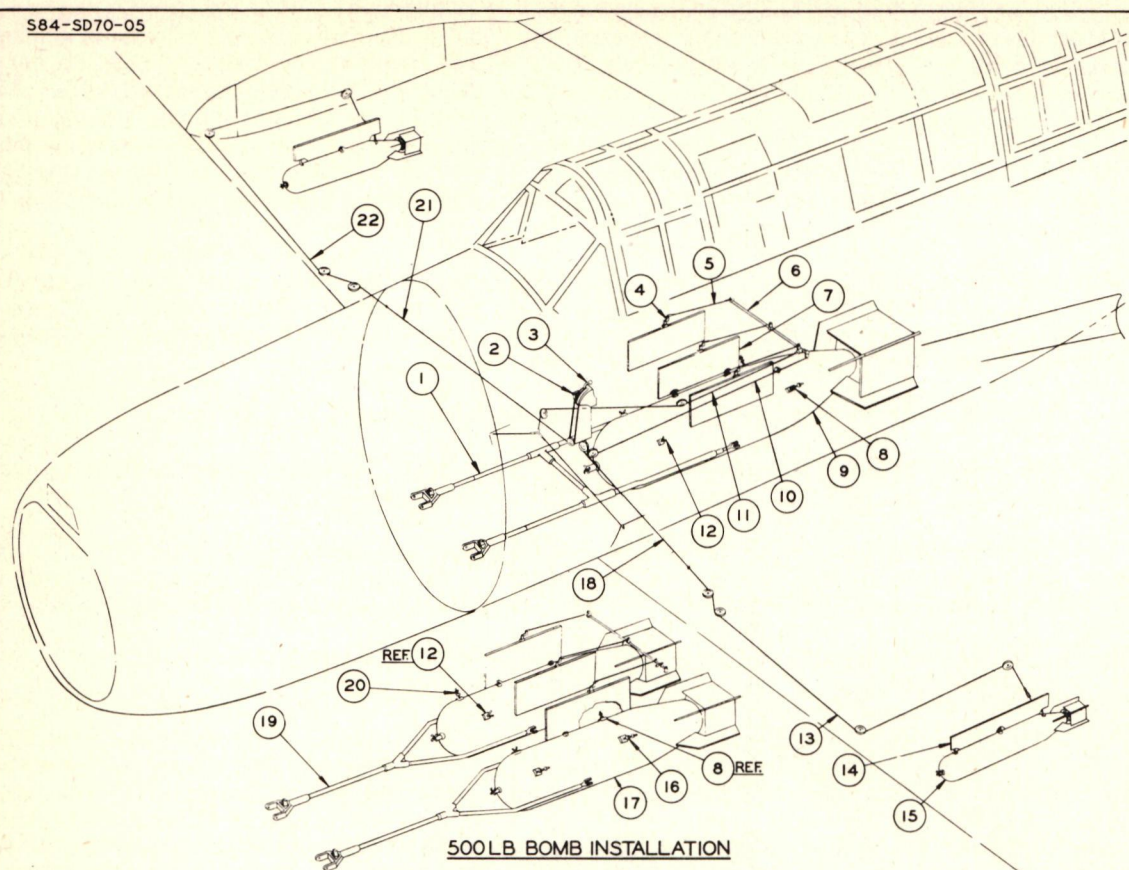
e. Maintenance.- The flexible gun is normally serviced by armament personnel. Removal of the gun from the mount is described in the section on installation. Minor repairs such as repairing seat, seat carriage, sight mechanism, floor, horizontal motor, and all parts attached to the ring with the exception of the ammunition box and main vertical drive assembly, may be done with the turret in the airplane. If it becomes necessary to do any major repair work on the main vertical drive assembly such as replacing gun mount casting or repairing ammunition box, it will be necessary to remove the turret from the airplane. The gears in the main vertical gear box may be replaced while the turret is in the airplane. If any repair work is to be done on the ammunition box due to bullet holes, it will be necessary to see that the entire inside of the box is smooth so that shells will feed properly.

There are several places that should be daily inspected on the turret. The vertical hydraulic motor release should be inspected to be sure that the motor will disengage freely. This is done by pulling out and down on the handle located on the vertical hydraulic motor. Hydraulic pressure should be applied to the turret and inspection made of tubing to be sure that there are no leaks. Also a daily check should be made to see that the seat is synchronized with the gun strut as explained in the operation of the hydraulic system. Periodic inspection should be made to insure that proper amount of grease is in the horizontal and vertical gear box cases.

Alignment of the gun sight and gun camera with the flexible gun so that their lines of action converge at a point 250 yards away is accomplished as follows: The fixed gun bore-sighting screen is used to intercept the lines of action of the gun, sight, and camera, and establishes their points on the screen. Points for the flexible gun, gun camera, and sight are in the upper right-hand corner of the screen. Points must be established for locating the position of landing gear wheels to establish center line of ship approximately parallel to screen. The screen is placed 30 yards from the center line of the ship. The distance from the point on Decal, which is located on the lower surface of the fuselage at station 282.50, should be equivalent to the distance from the center line of the propeller to the ground. By means of a bore-sighting tool, align the gun with bull's-eye on target. Then proceed to align the camera with the boresight tool which is inserted in the camera when the door is open. The sight is also aligned with its point on the screen. Points are established for parallel lines of fire and sight. Refer to fig. 4-VIII for details.

8. Bomb Loading.

a. Installing the bomb or bombs should be in accordance with the following procedure:



PARTS LIST - BOMB INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1		1000-pound Bomb Displacing Gear Assembly (Ref.)	S84-SD70-03
2		Salvo Bomb Release Assembly	S73-70-906
3		Bomb Release (Ref.)	S84-SD70-03
4		Bell Crank (Ref.)	S84-SD70-03
5		Cable Assembly (Ref.)	S84-SD70-03
6		Bomb Release Lock Assembly	S84-SD70-03
7		Bomb Rack (Ref.)	S84-SD70-03
8		Sway Brace (Ref.)	S84-SD70-03
9		1000-pound Bomb (Ref.)	S84-SD70-03
10	1	Mechanical Release Cable Assembly	S84-70-564-50
11		Bomb Control Cable Assembly (Ref.)	S84-SD70-03
12		Sway Brace (Ref.)	S84-SD70-03
13	1	Release Cable Assembly	S84-70-564-32
14		100-pound Bomb Rack (Wing) (Ref.)	S84-SD70-03
15		100-pound Bomb - General Purpose Bomb 100-pound AN-M-30 (Ref.)	S84-SD70-03
16		Sway Brace (Rear) (Ref.)	S84-SD70-03
17		500-pound Bomb (Ref.)	S84-SD70-03
18	1	Release Cable Assembly	S84-70-564-28
19		Displacing Gear Assembly (Ref.)	S84-SD70-03
20		Sway Brace Assembly (Ref.)	S84-SD70-03
21	1	Release Cable Assembly	S84-70-564-30
22	1	Release Cable Assembly	S84-70-564-36

This installation effective on airplanes AAF No. 41-18804 and up.

Figure 8-VIII - Bomb Installation

- (1) Open the bomb bay doors, either hydraulically or manually.
- (2) Open the special access door provided in the right bomb bay door to facilitate the use of the portable hoist.
- (3) Shut off the hydraulic pressure supply line from the engine pump and the accumulator by closing the main shut-off valve located directly forward of the hydraulic landing gear and flap operation control valve installed on the right side of the pilot's cockpit.
- (4) Release the spring-loaded locking pins at station 30 by pulling inboard on each knob, thus freeing the displacing gear struts.
- (5) Extend the displacing gear by hand, exercising extreme care that the gear does not extend too rapidly and strike the ground, damaging the gear.
- (6) Attach the desired displacing gear extension, if not already installed.

b. Install the bomb or bombs as follows: (The same instructions apply for the loading of each type bomb carried.)

- (1) Set the arming lever of the hand release mechanism at "SAFE."
- (2) Shift the proper release lever downward to unlatch the rack selected for loading.
- (3) Raise the bomb into place by means of a portable bomb hoist, type Mark II.
- (4) Suspend bomb from rack as specified in applicable armament instructions.
- (5) Retract the displacing gear by hand and adjust the forked ends to engage the trunnions of the bomb. The gear is held in this position by the bomb trunnions.
- (6) Engage the side lugs on the bomb by rotating the knurled knob, provided on each end of each displacing gear arm, in the clockwise direction until the spring-loaded ratchet releases.
- (7) Refer to applicable armament specifications for attachment of arming wire and removal of safety pins from bomb fuses.

c. Swaying of the bombs is prevented by rubber padded adjustable sway bracing assemblies. These assemblies are threaded into fittings on the under side of the wing beam and fuselage. After the installation of a bomb, the sway bracing should be adjusted to press firmly against the upper left and right surfaces of the bomb.

d. Release of Bombs.- Three switches are provided on the armament switch box for selecting the fuselage bomb or bombs to be dropped. The switches and their positions of operation are marked on the panel. Two of the bomb selector switches control the selection of right and left 500-pound bombs, while the third selects the 1000-pound bomb. The first two switches are moved up for individual selection of these bombs, and down for salvo selection. The release of the bomb or bombs is controlled electrically by a thumb button switch located on the upper end of the control stick. The bomb release switch, located on the pilot's stick, energizes a solenoid located in the bomb bay near the bomb rack. When the solenoid is energized, it operates the bomb release mechanism located in the bomb rack. As a safety feature, an electric switch, S84-66-537 left and right, prevents electrical release of the bombs until doors are fully open.

In an emergency, the bombs may be released manually. The manual release quadrant is located on the left side, forward of the pilot's seat. It is connected by means of cables and pulleys to a lever assembly aft of the bomb rack. The lever is fastened to the release mechanism of both bomb racks. When using this manual control, the bombs may be dropped in salvo only. On the lever assembly is a locking mechanism, used to prevent the manual bomb releasing mechanism from operating before the bomb bay doors are fully opened. A cable is fastened to the forward end of each door and a yoke secures these cables to a third cable which leads to a pin in the locking mechanism. When the doors are fully opened, the pin is withdrawn by the cable and the manual release mechanism may be operated.

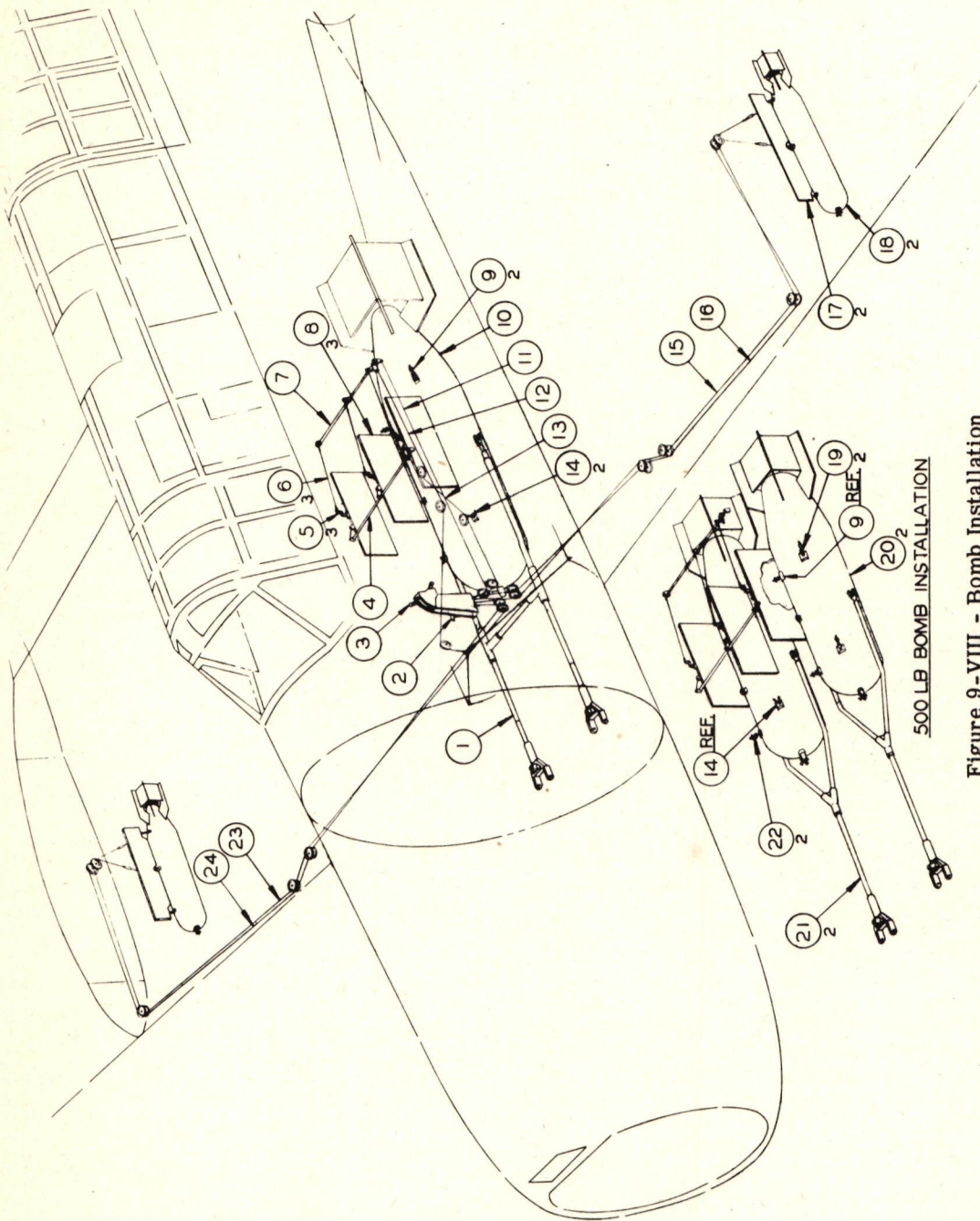


Figure 9-VIII - Bomb Installation

PARTS LIST - BOMB INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	1000-pound Bomb Displacing Gear Assembly	S84-70-532
2	1	Emergency Salvo Release Handle	S84-70-549-2
3	1	Bomb Release	B.O. 179000 Mark IV
4	3	Bell Crank	S84-70-717
5	1	Arming Tube Assembly	S84-70-583
6	3	Cable Assembly	S84-70-564-10
7	1	Bomb Release Lock Assembly	S84-70-585
8	3	Bomb Rack	B.O.328758 Mark 51-7
9	2	Sway Brace	S84-70-536-3
10	1	1000-pound Bomb	B.O.227487-A Mark V B.O.227488-A Mark IX B.O.227489-A Mark XIII B.O.227479 Mark VII
Alternates			
11	1	Bomb Release Cable Assembly	S84-70-549-5
12	1	Bomb Control Cable Assembly	S84-70-564-6
13	1	Arming Cable Assembly	S84-70-564-9
14	2	Sway Brace	S84-70-732
15	1	Release Cable Assembly	S84-70-564-1
16	1	Arming Cable Assembly	S84-70-564-3
17	2	100-pound Bomb Rack (Wing)	
18	2	100-pound Bomb General Purpose Bomb 100-pound AN-M-30	Air Corps H 3934768
19	2	Sway Brace (Rear)	S84-70-536-1
20	2	500-pound Bomb	B.O.227490-A Mark III * Mod. I B.O.264692-A Mark XII-I B.O.227480 Mark XI-I B.O.227491-A Mark IX
Alternates			
21	1L & 1R	Displacing Gear Assembly	S84-70-526
22	2	Sway Brace	S84-70-764 **
23	1	Release Cable Assembly	S84-70-564-2
24	1	Arming Cable Assembly	S84-70-564-4

Effective on airplanes AAF serial Nos. 41-17774 through 41-18104.

* B.O.301092 AN-MK33 1000-pound armor piercing bombs may be substituted for 500-pound bombs in both outboard racks.

** When the 1000-pound bombs are carried, the S84-70-764 sway braces are replaced with S84-70-960.

The manual arming of all bombs is accomplished by the lower rear lever on the wing bomb release quadrant. The connection from the lever to the arming assembly, S84-70-583, above the bomb racks is conventional in the use of cables and pulleys. The arming mechanism allows the bombs to be released in armed or safe condition. This is accomplished by placing the mechanism in either the "ARMED" or "SAFE" position. When in the "ARMED" position, the mechanism removes the arming wire from the bomb causing it to explode when dropped. When the mechanism is in the "SAFE" position, the arming wire is not removed from the bomb, and the bomb does not explode when dropped.

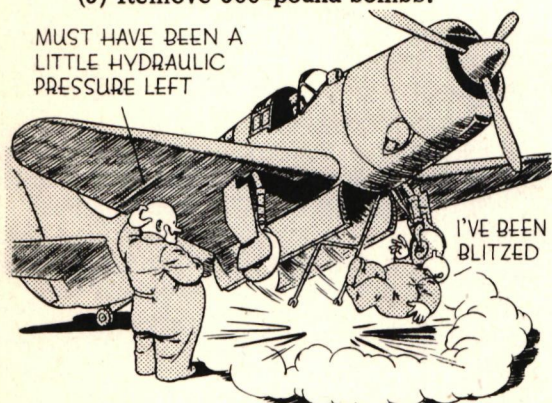
Provisions are made for the pilot and gunner to observe the bombs and the condition of the arming mechanism. Two lights are located in the bomb bay and visibility is afforded through plexiglass windows in the pilot's floor and in the aft cockpit floor. The two lights are controlled by a switch in the armament switch box. Mirrors are used in the bomb bay to direct the line of sight at nose and tail arming wires. The mirrors are adjusted manually with the bombs in place.

e. Sighting.- The fixed gun sight is used for sighting the target when dive bombing. The target approach doors, when open, enable the pilot to view the territory below the plane. The control for the approach doors is located on the floor of the cockpit to the left of the control stick. To open the doors, the control is depressed. A window is located in the floor of the cockpit forward of the control stick to provide a view through the approach doors.

9. Operation Sequence for Bomb Drop-Test.

a. 500-Pound Bomb Drop-Test.-

- (1) Install 500-pound bombs.
- (2) Adjust sway braces.
- (3) Attach 500-pound displacing gears to bomb trunnions.
- (4) Close bomb bay doors and check safety factors by trying to release bombs both manually and electrically.
- (5) Remove 500-pound bombs.



CAUTION: Be sure pressure is dumped in hydraulic system before disconnecting displacing gears from the bomb trunnions.

- (6) Lower displacing gears as far as possible. Trip selector valves to the "RETRACT" position. Start engine, holding back on the displacing gear at the same time.

CAUTION: Keep clear of path of displacing gears.

(7) When 1000-pound hydraulic pressure is obtained, let go of displacing gears. The gears should return to their "LATCHED" position.

- (8) Remove the four arms from the displacing gear V castings.
- (9) Cycle displacing gears both selective and salvo.
- (10) Install weight loading bars and 500-pounds of shot bags on both left and right bomb racks.
- (11) Drop-test manually, then selective and salvo electrically.

b. 1000-Pound Bomb Drop-Test.-

- (1) Install 1000-pound displacing gear.
- (2) Install 1000-pound dummy bomb and connect displacing gear to bomb trunnions.
- (3) Close bomb bay doors and try to release bomb both manually and electrically.
- (4) Remove 1000-pound bomb.

CAUTION: Be sure pressure is dumped in hydraulic system before disconnecting displacing gears from the bomb trunnions.

- (5) With hydraulic pressure still released, lower displacing gear as far as possible. Trip selector valves to the "RETRACT" position. Start engine and at the same time hold back on the displacing gear.

CAUTION: Keep clear of path of the displacing gears.

(6) When 1000-pound hydraulic pressure is obtained, let go of the displacing gears. The gears should return to the "LATCHED" position.

(7) Remove the two arms only from the 1000-pound displacing gear.

(8) Install weight loading bar and 1000 pounds of shot bags to center bomb rack.

(9) Release weight both manually and electrically.

NOTE: If dummy bombs are not available, shot bags or equal may be used for tests.

c. Maintenance.-

(1) General.- All cables should be properly adjusted and inspected for fraying and rust. Cables should be so adjusted that 75 percent of their travel has been completed before the operation they are to perform has been finished. The bomb racks require frequent overhaul for removing accumulation of products of corrosion, dirt, etc. The racks are to be lubricated at overhauls mentioned above. All bearing surfaces should be lubricated with machine gun oil, Specification No. 2-27. Racks that have become wet with sea water should be washed with fresh water and then thoroughly dried. Do not paint or polish the racks.

(2) Fusing and Unfusing of Bombs.- With a bomb load installed in the airplane, it may be desired to unfuse the bombs, or if the bombs are not already fused, it may be desired to fuse them. Whichever the case may be, the displacing gear must be lowered to allow enough clearance for the installation of the fuse, with the bomb installed. To lower the displacing gear, first shut off the pressure from the accumulator and engine pump; release the existing pressure from the system by operating the wing flaps; disengage the forked ends of the gear from the bomb trunnions; pull the displacing gear down the necessary distance; install the fuse or remove it as desired, by referring to applicable armament specification. Return the displacing gear to the retracted position by hand, and engage the forked ends to the bomb trunnions.

10. Auxiliary Fuel Tank Installation.

a. General.- An auxiliary fuel tank, S84-45-502, may be installed in the bomb bay on the center bomb rack in the same manner as either the 1000 or 1600-pound bomb. The installation, therefore, is similar to the large bomb installation. The capacity of the tank is 130 U. S. gallons (108 Imperial gallons). The auxiliary fuselage fuel line enters the top of the tank and extends nearly to the bottom. The fuel line goes to the selector valve, which is controlled by the pilot to select fuel from any tank desired. The auxiliary fuselage fuel line is a one-inch, self-sealing line. A connection from the gage transmitter on the tank runs to the electric fuel quantity gage located on the instrument panel. A vent line is provided in the tank.

The tank may be released in an emergency by opening the bomb bay doors and pulling the emergency bomb release handle, the fuel line leading from the tank having a separable connection therewith.

b. Maintenance.- Care must be taken that the tank is secure in the bomb racks. The tank must be properly vented.

11. Wing Bomb and Smoke Tank Installation.

a. General.- Provision is made for the installation of either an MK 50-1 B.O.328404 bomb rack or a practice bomb rack MK XLIII, B.O.182990-A, located on the lower outer panel of each wing at station 122. The MK 50-1 bomb rack is capable of carrying either one 100-pound bomb, one smoke tank MK VII, Mod. 1, or one depth bomb MK XVII. The practice bomb rack MK XLIII carries five miniature practice bombs, MK V-1.

b. Installation.- The bomb racks, either MK 50-1 or MK XLIII, is fitted beneath the wing by a front support tube, S82-70-321-4, which fits in a bushing, S84-70-550, forward of the main beam and a rear support tube, S84-70-321-3, which fits into a bracket assembly, S84-70-551. The arming cable and release cable assemblies run from the bomb arming handle and the bomb

release handle respectively down to a pulley bracket, S84-70-556, that is bolted to fuselage and to another set of pulleys, brackets S84-70-554 and S84-70-553 in the center panel. There are two sets of pulleys at station 122 through which the cables run to the wing bombs. Pulleys AN-210-2A are fastened to bracket S84-70-555 at station 122, and the pulleys directly over the bombs are fastened to bracket S84-70-556.

c. Operation.- The wing bombs or smoke tanks may be released manually or electrically. The release of the bombs is controlled manually by cables which lead from the bomb release handle located on the pilot's cockpit floor on the left side of the airplane. Each bomb may be armed before releasing by means of the arming handle located on the lower side of the bomb release quadrant. The arming handle is moved forward to the "ARMED" position. This operation arms the fuselage bombs as well as the wing bombs. Either one or both wing bombs may be dropped at a time. The bombs are released electrically by use of the two wing bomb switches (left and right) located on the armament switch box.

d. Maintenance.- The cable assemblies are adjusted to the proper tension to insure satisfactory arming and release of the wing bombs. The arming handle is attached to the wing bomb and fuselage arming cables by a bolt, AN23-15; the nut AN320-3 is screwed on moderately tight, then backed off far enough to relieve binding of parts, and a cotter pin, AN380C2-2, is inserted.



Section IX

HYDRAULIC SYSTEM

The hydraulic system of the Model A-25A Airplane is quite extensive. To avoid confusion and to provide the clearest possible understanding of the installations involved, the entire system will, for discussion, be divided into the main pressure supply portion and the various operating sub-systems, as follows:

- Hydraulic Pressure Supply System
- Landing Gear Hydraulic System
- Flap Hydraulic System
- Brake Hydraulic System
- Gun Hydraulic System
- Bomb Bay Door and Bomb Displacing Gear Hydraulic System
- Turtleback Hydraulic System
- Turret Hydraulic System

As divided above, the operating systems function independently of each other, and each obtains operating pressure directly from the hydraulic pressure supply system.

The various portions of the hydraulic system are shown in perspective and schematic form on the following drawings as noted:

<u>Figure</u>	<u>Title</u>
1-IX	Complete Hydraulic System (Schematic)
2-IX	Main Hydraulic System (Perspective)
14-IX	Landing Gear and Flap Hydraulic System (Perspective)
8-IX	Landing Gear and Flaps (Schematic)
18-IX	Brake Hydraulic System (Perspective)
21-IX	Gun Charger and Turtleback Hydraulic System (Perspective)
9-IX	Wing Hydraulic Lines Arrangement (Perspective)
30-IX	Turret and Turtleback Hydraulic System (Schematic)
24-IX	Bomb Doors and Displacing Gear Hydraulic System (Perspective)
25-IX	Bomb Doors and Displacing Gear Hydraulic (Schematic)

1. Hydraulic Pressure Supply System.

The hydraulic pressure supply system of the Model A-25A Airplane is of the accumulator type. The system comprises a fluid reservoir, an engine-driven hydraulic pump, a pressure regulator, an accumulator, an accumulator charging valve, pump pressure and accumulator air pressure gages, a drain manifold, an emergency hydraulic pump (hand-operated), relief valve, necessary lines and fittings, and a shut-off valve.

Following a brief description of the operation of the pressure supply system, details relating to the operation and maintenance of the various units will be given.

a. Engine Pump Operation, Pressure Supply System.- Operation of the engine-driven hydraulic pump draws fluid from a bottom outlet of the hydraulic reservoir and discharges it into the line leading to the pressure regulator. If the fluid pressure in the accumulator is below approximately 850 pounds per square inch, the pressure regulator passes fluid from the pump into the main fluid pressure line which is connected to the top of the accumulator. At approximately

S84-SD33-48

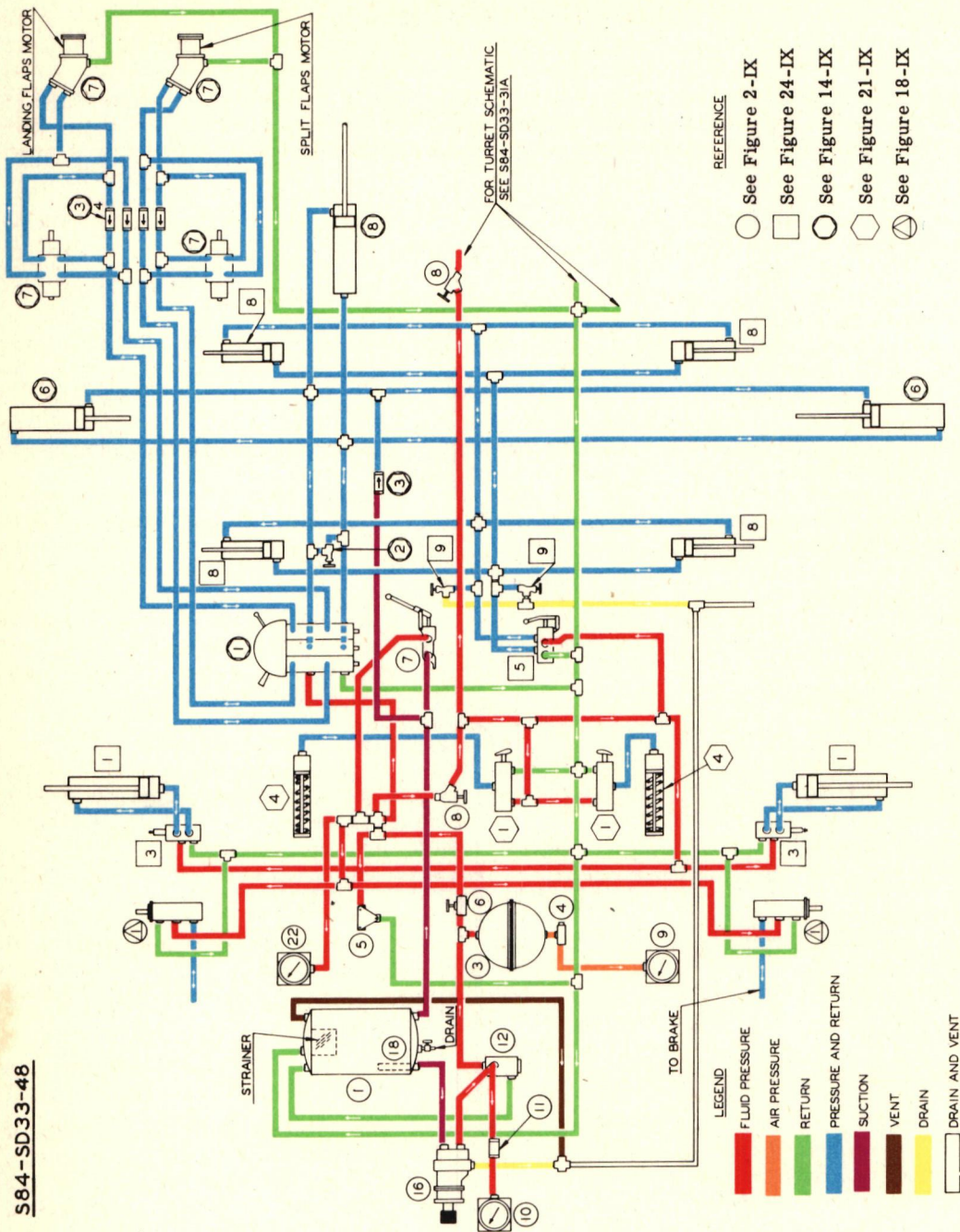


Figure 1-IX - Complete Hydraulic Schematic

1000 pounds per square inch accumulator pressure, the pressure regulator operates to bypass fluid from the engine-driven pump into a return line to the top of the fluid reservoir. A check valve in the pressure regulator prevents fluid discharge from the accumulator into the pressure regulating valve while fluid from the pump is being bypassed. While the pressure regulator is bypassing fluid, operation of any portion of the hydraulic system draws fluid from the accumulator and tends to lower the hydraulic pressure, since the fluid pressure stored by means of the accumulator depends directly upon the compression of a cushion of air in the lower portion of the accumulator. The pressure regulator, being an automatic mechanical unit, obviously requires a certain differential in pressure for its operation. In this particular installation, the differential pressure required is approximately 150 pounds per square inch, which means that, below approximately 850 pounds per square inch, the pressure regulator shifts the fluid flow of the engine-driven pump from the bypass line directly into the accumulator pressure line.

It is, of course, possible for the engine-driven pump to be working into the accumulator line at the same time that hydraulic pressure is being drawn from the accumulator. In this case, the engine-driven pump actually supplies most of the pressure demand directly to the main supply line, the accumulator serving to absorb any excess fluid delivered by the pump or to supply any additional fluid required by the operating systems. Also, in such a case, the operating pressure may fluctuate to some extent, the actual pressure at any time depending upon the supply of fluid available from the pump and accumulator and the demand of the operating system.

b. Pressure Regulating Valve.

(1) Function. - The function of this unit is to act as a pressure control valve (or pressure regulator) which will automatically divert pump delivery to the reservoir without flow restriction, as accumulator pressure reaches a desired maximum; or to direct pump delivery to the accumulator and the hydraulic control system when the accumulator pressure drops to a predetermined minimum. Oil flow at "pump delivery inlet connection" is directed to "pressure outlet connection" until pressure reaches predetermined maximum figure, at which time inlet flow is diverted to "discharge outlet connection" while an internal check valve prevents loss of accumulator pressure through the pressure regulating valve. (Inlet and outlet ports are indicated on valve body.)

Check piping connections against typical hydraulic circuit diagram given on hydraulic system layout. It is desirable that the line between the pressure regulating valve and the accumulator be made as short as possible to eliminate flow restriction. On all internally drained valve models, the discharge connection to the oil reservoir must be free from restriction so that discharge pressure at the "discharge outlet connection" does not exceed 20 pounds per square inch.

(2) Adjustments. - Refer to fig. 3-IX. Adjustments of operating pressure are made at assembly and cannot be changed except by replacing spring, item 14. Pressure adjustments will be altered slightly by a variation of cap, item 13, tightness; therefore, cap should be pulled up snugly to its approximate original position. This will insure that correct operating pressures will be obtainable after reassembly.

(3) Disassembly and Assembly. - Remove the four nuts, item 23, that secure cover, item 9. This will allow inspection of spring, item 10. Removal of opposite cover, item 4, in like manner will permit inspection of directional spool, item 11, and unloading spool, item 5. Both spools should operate very freely in their respective bores. This will also allow inspection of check valve, item 7, and spring, item 6. Check valve must operate freely in its bore and seat must be in good condition.

Unscrewing cap, item 13, will allow access to spring, item 14, guide, item 21, and pilot valve spool, item 17. Pilot valve must operate freely in its bore. Removal of plug, item 19, allows access to plunger, item 18. This too must operate freely in its bore. Gaskets, items 12 and 2, should be checked to make sure that they have not been blown-out or torn. Check all drilled passages to make certain that they are free from foreign matter and particularly the small restriction inserts under the covers and adjacent to the directional spool bore.

To reassemble, the reverse of the above procedure for dismantling is recommended although not absolutely necessary. Make certain that cover, item 9, is replaced correctly, and

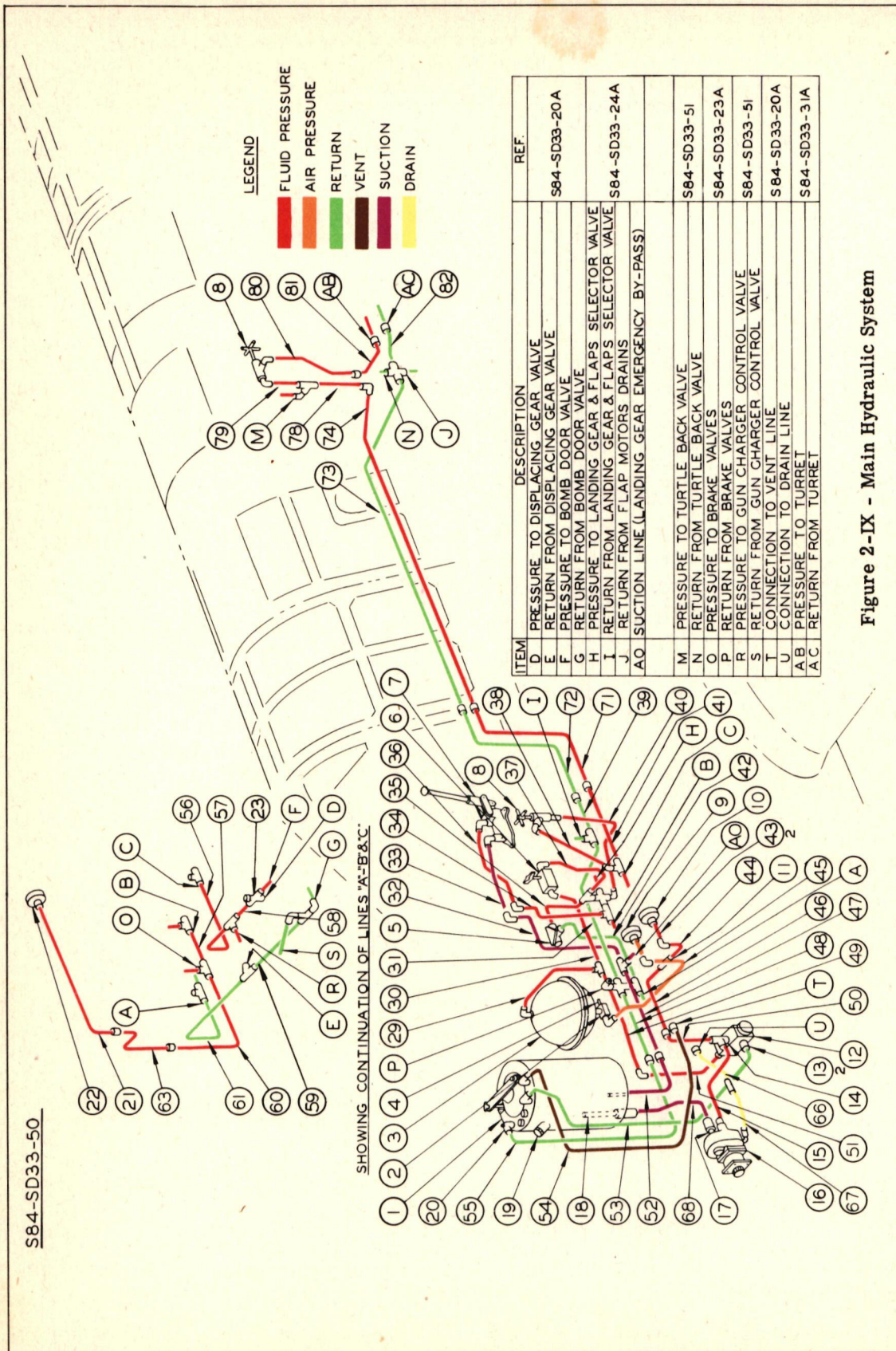
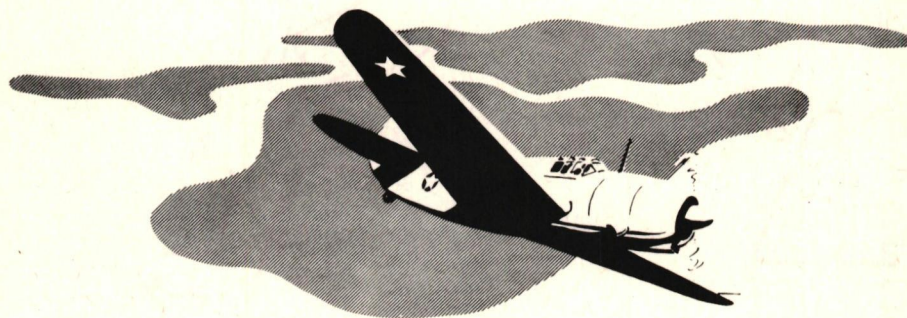


Figure 2-IX - Main Hydraulic System

PARTS LIST - MAIN HYDRAULIC SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Hydraulic Reserve Tank Assembly	S84-33-629
2	1	Tee	S84-33-823
3	1	10-inch Diameter Accumulator	S84-SD33-28
4	1	Air Valve	S84-SD33-28
5	1	Relief Valve	Vickers D-61646
6	1	Accumulator Charging Valve	Adel D-9668
7	1	Hydraulic Hand Pump See	S84-SD33-18
8	2	Shut-Off Valve	S84-33-668
9	1	Accumulator Air Press Gage	S84-61-599
10	1	Hydraulic Pump Pressure Gage	S84-61-579
11	1	Snubber	Ray Pressure Snubber Co. 11-D
12	1	Pressure Regulator Valve	Vickers AA14516 (850-1000)
13	2	Reducer	S84-33-709
14	1	Elbow	S84-33-822
15	1	Hose Assembly	AN861-10D-30
16	1	Hydraulic Pump	Pesco #IP-249L-Position B
17	1	Fitting	S84-33-850
18	1	Stand Pipe	S84-33-635
19	1	Filler Plug	S84-33-392
20	1	Elbow	S84-33-830
21	1	Hose Assembly	AN857-4D-21
22	1	Hydraulic System Pressure Gage	S84-61-598
23	1	Cross	S84-33-645



LINE ASSEMBLIES - MAIN HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
29	S84-33-936-19	1	Pressure Line from Top of Accumulator to Tee	1/2 x .042	21.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D * AN819-8 AN819-8 *B*
30	S84-33-936-561	1	Pressure Line from Tee to Shut-Off Valve	5/8 x .049	6.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D * AN819-10 AN819-10 ** *B*
31	S84-33-936-4	1	Return Line from Rear of Cross to Tee	5/8 x .042	16.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *
32	S84-33-936-93	1	Suction Line from Tee to Pilot's Floor	3/8 x .035	15.75	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D * AN819-6 AN819-6 ***
33	S84-33-936-45	1	Suction Line from Pilot's Floor to Hand Pump	3/8 x .035	12.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D * AN819-6 AN819-6 ***
34	S84-33-936-44	1	Pressure Line from Tee to Pilot's Floor	3/8 x .035	10.0	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D * AN819-6 AN819-6 ***
35	S84-33-936-558	1	Pressure Line from Relief Valve to Tee	1/2 x .042	8.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D * AN819-8 AN819-8 *
36	S84-33-936-46	1	Pressure Line from Pilot's Floor to Hand Pump	3/8 x .035	15.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D * AN819-6 AN819-6 ***
37	S84-33-936-557	1	Pressure Line from Outboard Shut-Off Valve to Tee	5/8 x .049	9.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D * AN819-10 AN819-10 **
38	S84-33-936-78	1	Pressure Line from Inboard Shut-Off Valve to Top of Tee	5/8 x .049	10.75	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D * AN819-10 AN819-10 **

RESTRICTED

Section IX

LINE ASSEMBLIES - MAIN HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
39	S84-33-936-5	1	Return Line from Tee to Station 35.00	5/8 x .042	4.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10
40	S84-33-936-79	1	Pressure Line from Inboard Shut-Off Valve to Cross	5/8 x .049	15.75	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10 **
41	S84-33-936-13	1	Pressure Line from Tee to Station 35.00	5/8 x .049	9.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10 **
42	S84-33-936-559	1	Return Line from Relief Valve to Tee	1/2 x .042	9.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D* AN819-8 AN819-8
43	S84-33-936-65	2	Pressure Line from Pilot's Floor to Pressure Gage	1/4 x .035	5.00	Alum. Al. 52SO WW-T-787	AN818-4D AN818-4D* AN819-4 AN819-4 *A*
44	S84-33-936-503	1	Pressure Line from Snubber to Pilot's Floor	1/4 x .035	6.00	Alum. Al. 52SO WW-T-787	AN818-4D AN818-4D* AN819-4 AN819-4 *A*
45	S84-33-936-66	1	Pressure Line from Accumulator to Pilot's Floor	1/4 x .035	25.00	Alum. Al. 52SO WW-T-787	AN818-4D AN818-4D* AN819-4 AN819-4 *A*
46	S84-33-936-502	1	Pressure Line from Station 0.00 to Snubber	1/4 x .035	25.00	Alum. Al. 52SO WW-T-787	AN818-4D AN818-4D* AN819-4 AN819-4 *A*
47	S84-33-936-92	1	Suction Line from Tee to Station 0.00	3/8 x .035	11.75	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D* AN819-6 AN819-6 ***

LINE ASSEMBLIES - MAIN HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
48	S84-33-936-9	1	Return Line from Cross to Station 0.00	5/8 x .042	6.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10
49	S84-33-936-560	1	Pressure Line from Station 0.00 to Tee	5/8 x .049	4.50	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10 ** *B*
50	S84-33-936-71	1	Pressure Line from Pressure Regulator to Station 0.00	1/4 x .035	11.00	Alum. Al. 52SO WW-T-787	AN818-4D AN818-4D* AN819-4 AN819-4 *A*
51	S84-33-936-16	1	Pressure Line from Pressure Regulator to Station 0.00	5/8 x .049	11.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10 **
52	S84-33-936-42	1	Suction Line from Tank to Station 0.00	5/8 x .035	8.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D* AN819-6 AN819-6 ***
53	S84-33-936-17	1	Return Line from Pressure Regulator to Top of Tank	5/8 x .042	41.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10
54	S84-33-936-70	1	Vent Line from Top of Tank to Station 0.00	1/4 x .035	33.00	Alum. Al. 52SO WW-T-787	AN818-4D AN818-4D* AN819-4 AN819-4 *A*
55	S84-33-936-18	1	Return Line from Fire Wall to Top of Tank	5/8 x .042	41.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D* AN819-10 AN819-10 *
56	S84-33-936-40	1	Pressure Line from Tee to Tee	3/8 x .035	20.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D* AN819-6 AN819-6 ***

RESTRICTED

Section IX

LINE ASSEMBLIES - MAIN HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
57	S84-33-936-50	1	Pressure Line from Tee to Tee	3/8 x .035	4.00	Alum. Al. 52SO WW-T-787	AN818-6D AN819-6 * AN819-6 ***
58	S84-33-936-32	1	Pressure Line from Tee to Cross	3/8 x .035	3.00	Alum. Al. 52SO WW-T-787	AN818-6D AN819-6 * AN819-6 ***
59	S84-33-936-11	1	Return Line at Side of Tee on Center Line to Tee	5/8 x .042	12.00	Alum. Al. 52SO WW-T-787	AN818-10D AN819-10 * AN819-10 AN819-10
60	S84-33-936-76	1	Pressure Line from Tee to Pilot's Floor	1/4 x .035	17.00	Alum. Al. 52SO WW-T-787	AN818-4D AN819-4 * AN819-4 *A*
61	S84-33-936-562	1	Return Line from Tee to Tee on Center Line	5/8 x .042	25.75	Alum. Al. 52SO WW-T-787	AN818-10D AN819-10 * AN819-10 AN819-10
62	S84-33-936-75	1	Pressure Line from Pilot's Floor to Hose Assembly	1/4 x .035	21.00	Alum. Al. 52SO WW-T-787	AN818-4D AN819-4 * AN819-4 *A*
66	S84-33-941-5	1	Drain Line (Lower) from Pesco Pump	1/4 x .035	25.00	Alum. Al. 52SO WW-T-787	AN818-4D AN819-4 Beaded
67	S84-33-941-4	1	Drain Line (Upper) from Pesco Pump	1/4 x .035	9.50	Alum. Al. 52SO WW-T-787	Beaded Beaded
68	S84-33-941-3	1	Supply Line from Reservoir to Pesco Pump	1 x .049	27.19	Alum. Al. 52SO WW-T-787	Beaded Beaded
71	S84-33-938-2	1	Pressure Line from Station 35.00 to Center Panel Support	5/8 x .049	28.81	Alum. Al. 52SO WW-T-787	AN818-10D AN819-10 * AN819-10 AN819-10

LINE ASSEMBLIES - MAIN HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
72	S84-33-938-3	1	Return Line from Station 35.00 to Center Panel Support	5/8 x .042	27.25	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *
73	S84-33-930-19	1	Return Line from Support S84-33-896 to Cross	5/8 x .049	53.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *
74	S84-33-930-20	1	Pressure Line from Support S84-33-896 to 90° Elbow	5/8 x .049	53.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *
78	S84-33-939-23	1	Pressure Line from Tee to Top of Center Panel	5/8 x .049	8.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 **
79	S84-33-939-22	1	Pressure Line from Turret Shut-Off Valve to Tee	5/8 x .049	5.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 **
80	S84-33-939-24	1	Pressure Line from Top of Center Panel to Turret Shut-Off Valve	5/8 x .049	14.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 **
81	S84-33-939-34	1	Pressure Line from Top of Center Panel to Rear of Center Panel	5/8 x .049	18.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 **
82	S84-33-939-29	1	Return Line from Cross to Rear of Center Panel	5/8 x .042	15.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *

- * Substitute AC 811T-CS type sleeve for AN819- sleeve on airplanes 41-18774 through 41-18798
- ** Substitute 5/8 x .042 tubing for 5/8 x .049 tubing on airplanes 41-18774 through 41-18778
- *** Substitute 3/8 x .032 tubing for 3/8 x .035 tubing on airplanes 41-18774 through 41-18778
- *A* Substitute 1/4 x .042 tubing for 1/4 x .035 tubing on airplanes 41-18774 through 41-18778
- *B* Parts used on airplanes 41-18774 through 41-18823 only

that gaskets, items 12 and 2, are in correct position so that cut-outs in gaskets correspond to correct grooves in covers.

PARTS SHOULD BE ABSOLUTELY CLEAN BEFORE BEING REASSEMBLED

NOTE: When a hydraulic connection is broken, the male and female fittings will be capped and plugged. No dirt must be allowed to enter the hydraulic system. The smallest particles of dirt are most injurious to the system. The automatic and manually controlled valves will be fouled by dirt particles which are too small to be seen with the naked eye.

c. Hand Pump Operation, Pressure Supply System.- Hydraulic pressure may be obtained by means of the hydraulic hand pump when the engine is not running, or when the engine-driven pump fails. As normally operated, the hand pump does not build up pressure in the accumulator, but supplies pressure directly to the portion of the system being operated. This is due to the normal action of the manually controlled check valve (item 6, fig. 1-IX) which isolates the accumulator from any back pressure produced beyond the valve. If the valve control is set to hold the check valve open, operation of the hand pump will build up pressure in the accumulator. Fluid supply for the hand pump is obtained from an outlet in the bottom of the hydraulic reservoir. Any excess pressure developed by the hand pump is relieved through the relief valve (fig. 5-IX).

d. Liquid Operated or Liquid Operating Pistons Using Packing Rings.-

(1) To Remove the Piston.-

Remove packing nut.
Inspect inside of cylinder above piston.
If cylinder is corroded above piston travel, wipe or hone smooth.
Replace packing nut hand tight.
Vent cylinder above piston to atmosphere.
Pull piston back till it touches packing nut.
Remove nut and piston.

NOTE: If piston is too tight to be pulled out by hand, vent cylinder below piston and apply hydraulic pressure to top of piston to force it back to packing nut.

WARNING: Do not apply pressure too fast as a sudden "break-loose" of stuck or tight piston may cause it to hit packing nut with damaging force.

(2) Keep the nut in place until the piston has been pulled all the way back. This eliminates the possibility of scoring the cylinder. To re-install, reverse the disassembly procedure and add the following:

(a) Cut a piece of .002-inch shim brass of just sufficient length to go around piston and slightly wider than packing.

(b) Oil shim brass.

(c) Wrap around piston over packing and gently insert piston in cylinder.

(d) As soon as all packing has entered cylinder, pull evenly on shim brass to remove from cylinder. Do not take hold of corner of shim brass and try to remove it. This will twist and tend to distort it and will no doubt cut the packing. As the shim brass is used to protect the packing, be sure to use it in such fashion that protection is assured.

Become adept in the use of this method of installing packing, as it will apply and be referred to in the installation of all pistons, using packing for a seal, where the tolerance between packing and cylinder is great enough to permit such use.

NOTE: Always soak hydraulic packing in hydraulic fluid, Specification No. AN-VV-O-366a, before installing. Lubricate all parts thoroughly with hydraulic fluid before reassembly.

SERVICE DRAWING
NO 584-SD33-27

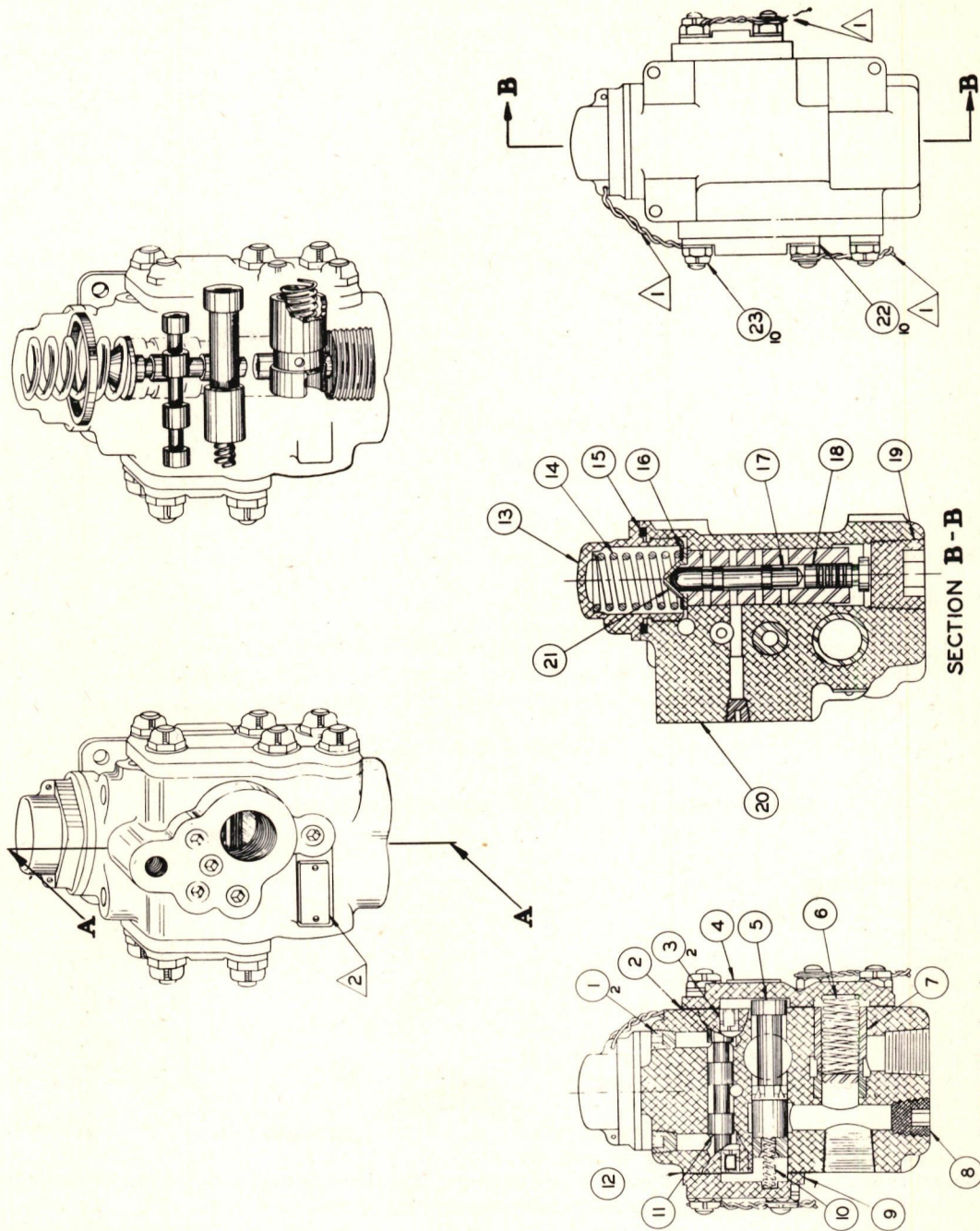


Figure 3-IX - Hydraulic Pressure Regulator

PARTS LIST - HYDRAULIC PRESSURE REGULATOR

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	2	Plug	41323
2	1	Gasket	46137
3	2	Plug	49300
4	1	Cover	46135
5	1	Spool	49709
6	1	Spring	38792
7	1	Valve	38778
8	1	Plug	38131
9	1	Cover	49483
10	1	Spring	50066
11	1	Spool	46126
12	1	Gasket	46138
13	1	Housing	46142
14	1	Spring	46131
15	1	Gasket	46125
16	1	Washer	54950
17	1	Spool	48105
18	1	Plunger	49556
19	1	Plug	39463
20	1	Body - Subassembly	65308
21	1	Guide	46130
22	10	Washer	3X-49072
23	10	Nut	3X-34567

NOTES:

- ① Lock wire as required.
- ② Specify model number and serial number in addition to part number, when ordering repair parts. The serial number makes possible the substitution of correct part numbers where design changes have been made.
3. This assembly conforms to "Vickers" Inc. No. AA-14516 (850-1000).

e. Trouble Shooting.-

(1) General.-

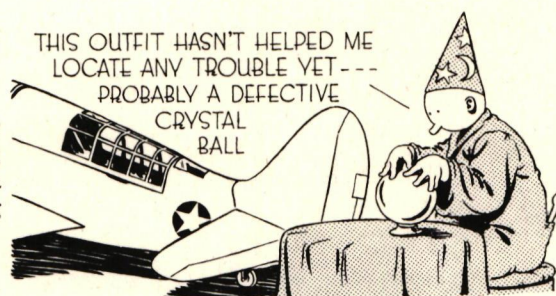
(a) The part an expert trouble shooter plays on a flying field cannot be over-stressed; however, the expert trouble shooter is not a phenomenon. He is, rather, the result of long experience and clear and logical thinking.

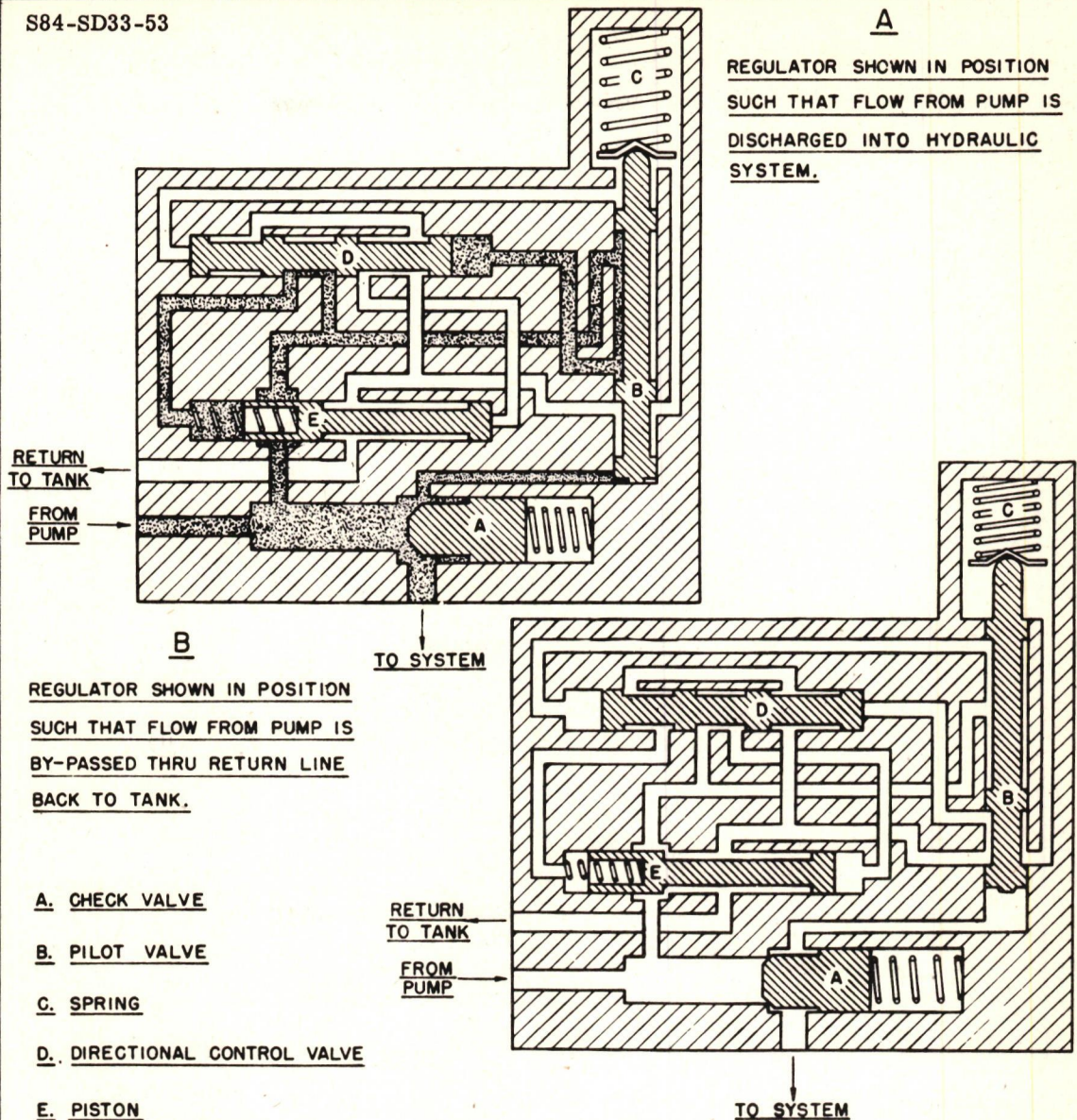
Realizing this, the apprentice mechanic should make every effort to work with an experienced trouble shooter and observe his procedure. He should develop the habit of diagnosing troubles by certain symptoms, often before the trouble actually occurs. This can only be done by constant study and observation of the particular type of work to which he is assigned.

The Crew Chief necessarily must be expert on every part of the airplane under his charge.

(b) The first requirement of the trouble shooter is that he take nothing for granted.

DON'T ALLOW YOUR MECHANICS TO BECOME CARELESS ON INSPECTIONS!



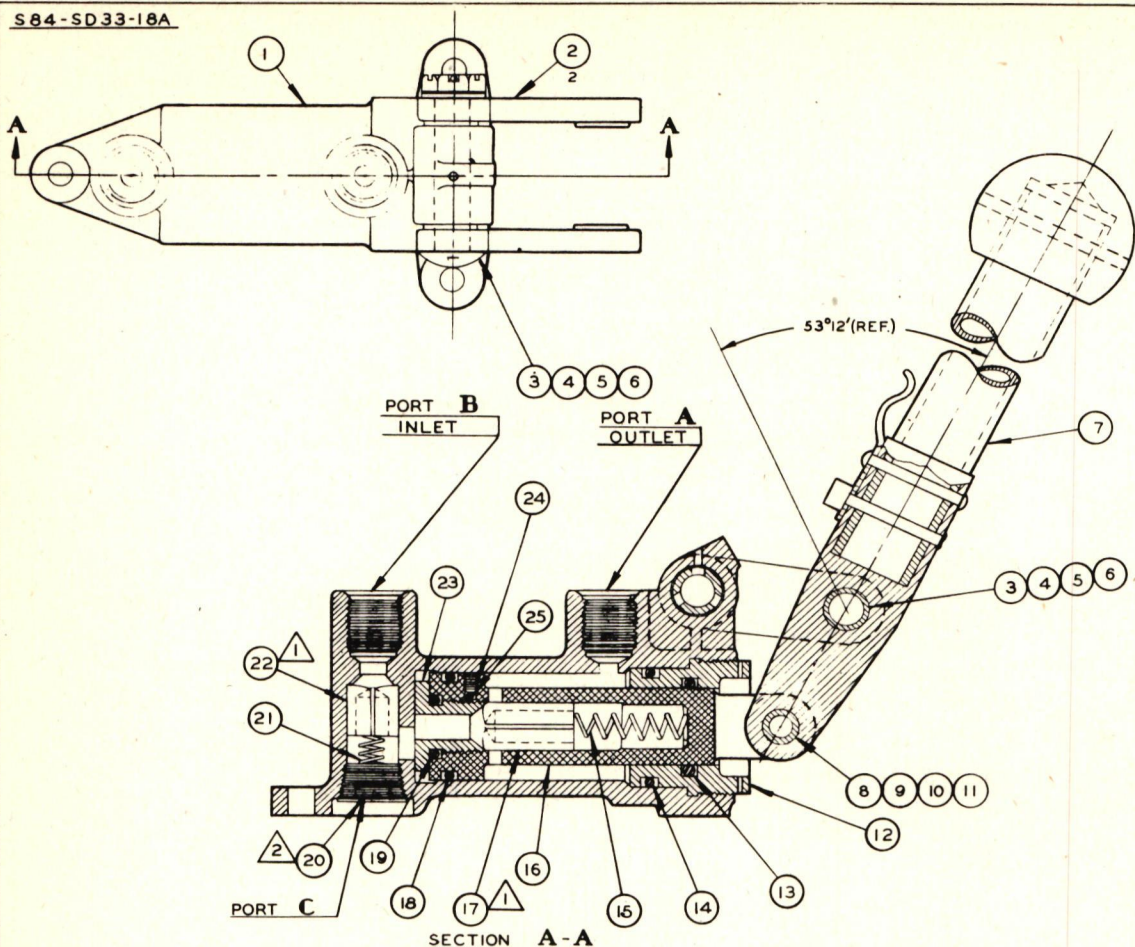


Operation: See figure A. Fluid under pressure from the pump forces check valve "A" back against a light spring, opening the system line and also putting pressure on the bottom end of pilot valve "B," which is held down by spring "C." Pump pressure is put on the right hand end of directional control valve "D" through porting around piston, forcing piston "D" to the left. Piston "D," moving over to the left end, opening porting so that pump pressure is put against the left end of unloading valve "E," assisting the spring in holding the valve to the right-hand end, and thus blocking off the pressure from the return line.

As the pressure in the system builds up, piston "B" is raised against spring "C" until the porting is changed. See figure B. Pressure from the pump is now put against the left-hand end of the piston "D," forcing it over to the right. Piston "D," moving to the right, changes the porting so that the pump pressure forces piston "E" to the left against a light spring. As piston "E" moves to the left, it opens a port so that flow from the pump may bypass into the return line back to the tank. As the pump flow bypasses to the return line, pressure is relieved, allowing check valve "A" to be closed by the spring behind it. Check valve "A" blocks off the system from the return line.

Figure 4-IX - Schematic Diagram of Vickers Pressure Regulator

S84-SD33-18A



(C.W. ASSEMBLY NO.S84-33-790)

Figure 5-IX - Hydraulic Hand Pump

PARTS LIST - HYDRAULIC HAND PUMP

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Body	S84-33-548
2	2	Link	S84-33-053
3	2	Clevis Bolt	AN26-32
4	2	Washer	AN960-C616
5	2	Nut	AN320-6
6	2	Cotter Pin	AN380-C3-3
7	1	Handle	S84-33-884
8	1	Clevis Bolt	AN24-17
9	1	Washer	AN960-C416
10	1	Nut	AN320-4
11	1	Cotter Pin	AN380-C2-2
12	1	Retainer	S84-33-723
13	1	Packing	AN6227-17
14	1	Packing	AN6227-21
15	1	Spring	S84-33-056-1
16	1	Piston	S84-33-724
17	1	Valve	S84-33-059-1
18	1	Packing	AN6227-19
19	1	Packing	AN6227-10
20	1	Plug	AN895-B102
21	1	Spring	S84-33-056-2

PARTS LIST - HYDRAULIC HAND PUMP

22	1	Valve	S84-33-059-2
23	1	Valve Seat	S82-33-354
24	1	Allen Setscrew	No. B-32
25	1	Plug	S84-33-629-2

NOTES:

- ① Lap seat in place.
- ② Sweat in place before testing.

INSTRUCTION: TESTING PROCEDURE.

1. Bursting Test: Apply 2500 pounds per square inch to ports "A" and "B" simultaneously. Test to be made on one pump only.
2. Pump must deliver one quart for 76 strokes (38 cycles) maximum at 500 pounds per square inch pressure.
3. With port "B" open, apply 1250 pounds per square inch pressure at port "A." Depress valve S84-33-059-2 with suitable instrument. Leakage from port "B" must not be more than five drops per minute.
4. Remove pressure from port "A." Move handle to position opposite that shown. Depress valve S84-33-059-2 with suitable instrument and fill port "B" with oil. Release valve and leave port "B" uncapped. Apply 2500 pounds per square inch to port "A." Leakage from port "B" must not be more than five drops per minute.
5. Use only hydraulic fluid, Specification No. AN-VV-O-366a, in testing.

Most troubles are corrected or avoided by proper inspection. Do not allow anyone to be in too big a hurry to properly inspect the airplane. Careless inspections are not to be tolerated and are sure to exact heavy penalties.

(c) It is obviously impossible to outline a definite procedure for trouble shooting. However, certain steps are obvious. The first step is the correct analysis of the problem. Here, generalities are of no use. The mechanic must be able to tie the trouble down to one or more causes; for example, if the engine will not idle properly, the most probable cause would be improper setting or adjustment of idling mixture control, etc. If this does not correct the condition, move to the next step in your checkout procedure until the trouble is located and corrected.

Always choose the most probable trouble first.

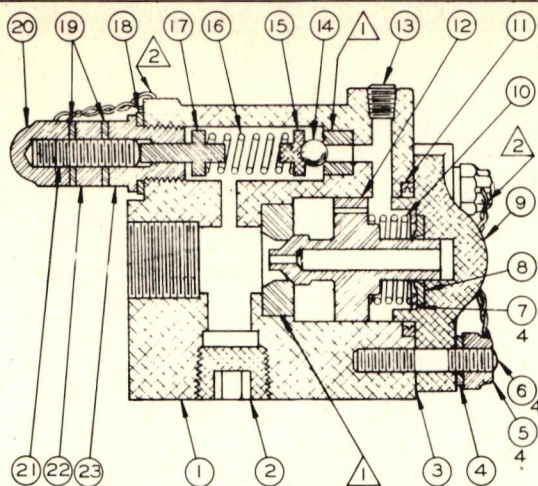
A trouble shooting procedure for the equipment discussed will be found at the end of each section of this book. It is suggested that any additional procedure known to the reader be inserted in the book for future reference.

f. Trouble Shooting Main Hydraulic System.-

Trouble shooting the main hydraulic system is simplified by the fact that the pumps (engine-driven and hand-operated) are placed at the extreme ends of this system. This arrangement allows the trouble shooter to apply pressure to both sides of each item comprising the main hydraulic system.

g. Reservoir.-

(1) The reservoir will be cleaned at each 100-hour inspection. Remove the screen and clean as follows: Turn screen upside down and immerse in kerosene.



Ref. No.	Quantity	Item	Part No.
1	1	Valve Body	*
2	1	Plug	64014 *
3	1	Gasket	61391
4	4	Washer	3X-49072
5	4	Nut	3X-34567
6	4	Stud	3X-59159 *
7	1	Washer	50791
8	1	Seal	50790
9	1	Cover	59701
10	1	Spring	58299
11	1	Vickerseal	43697
12	1	Piston	43688
13	1	Plug	37829 *
14	1	Ball	14371
15	1	Retainer	54939
16	1	Spring	54982
17	1	Seat	51667
18	1	Gasket	42548
19	2	Gasket	48946
20	1	Nut	46246
21	1	Screw	51656
22	1	Nut	49264
23	1	Retainer	46234

* Items noted are parts of subassembly No. 72746.

NOTES:

- ① These valve seats are also parts of subassembly No. 72746 but are not recommended for replacement.
- ② Lock wires required as shown.
3. Operating pressure - 1650 pounds per square inch.
Normal capacity - 8 gallons per minute.
Venting pressure - 20 pounds per square inch.
4. Conforms with Specification No. AND10050 except that fittings into pressure ports must not enter more than 9/16 beyond face of bosses.
5. Drawing conforms to Vicker's drawing E66520 - Model AA-11503.

Figure 6-IX - Hydraulic Relief Valve

(2) Remove and blow out (from reverse side only). Continue to immerse and blow out until all foreign matter is removed.

(3) With all lines at bottom of reservoir disconnected, flush reservoir with kerosene or naphtha.

(4) Using clean cloth dampened with kerosene or naphtha, wipe inside of reservoir carefully and completely. Follow with dry cloth. After this operation, dry the hands thoroughly and, with a strong light in the reservoir, run hand around inside of reservoir to locate any foreign objects. The reservoir must be absolutely clean.

(5) Reconnect lines and refill reservoir. It will not be necessary to bleed the system as no air has entered lines in the above operation.

h. Engine-Driven Pump.

NOTE: Although pump overhaul is not first or second echelon work, it is well to know what to do in extreme emergencies.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Engine running, no hydraulic pressure at main system hydraulic gage (on floor board forward of control pedals.)	(a) Pump shaft sheared off.	1. Remove and replace pump.
(2) Engine running, pump does not develop 1000 pounds pressure (but does go above 90 pounds unloading pressure).	(a) Gear teeth are rough or fluid is bypassing between gears and pump cover.	1. Using magnifying glass and a piece of glass or small scraper, carefully smooth roughness from teeth of gears. It is absolutely necessary that teeth be perfectly smooth.

NOTE: Contrary to the belief of some mechanics, the fluid does not travel between the teeth of the pump. The fluid into the pump travels through intake port and around the outside of the gears (between teeth and pump body) to the discharge port. From this, it can be seen that the teeth must mesh perfectly to produce maximum pressure.

Check pump body and cover for wear. If wear shows on cover, place on fine emery cloth on surface plate and dress to a smooth surface. Lap finish. Reassemble pump. Remove shim paper until pump cannot be turned by hand. Add barely enough shims to allow free movement of shaft. Clean out pump drain opening.

WARNING: Replace any temporarily repaired pump as soon as possible as this repair is not to be considered as permanent.

i. Pressure Regulating Valve.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Valve will not charge accumulator.	(a) Unloading spool, item 5, or directional spool, item 11, stuck in "OPEN TO TANK" position, or broken unloading spring, item 10.	1. Dismantle valve and check operation of internal parts. Spools must be absolutely free in bores. Replace spring if necessary.
(2) Valve will not "unload" pump to tank.	(a) Broken pilot valve spring, item 14. Spools stuck in bores, or check valve stuck open.	1. Check and replace spring, if necessary. Dismantle to inspect and clean.

(3) Erratic "cut-in" and "cut-out" pressure readings.

(a) Spools sticking slightly in 1. Dismantle to inspect and bores, but not sufficiently clean. to make valve inoperative.

(b) Spools scored and burs raised at edges. 1. Smooth up spools with fine stone and remove burs. However, do not break sharp corners on spool lands.

(4) Chatter or excessive leakage. Valve not maintaining pressure in accumulator when there is no leakage in remainder of system.

(a) Check valve, item 7, leaking. 1. With pressure built up in the accumulator but pump shut off, disconnect pressure line and observe for excessive leakage. Replace check valve, or lap slightly with seat.

(b) Leakage past plunger, 18. 1. With pressure in accumulator, but pump shut off, disconnect tank line and check leakage. Should not exceed 30 drops per minute at approximately 37.8 degrees C (100 degrees F).

NOTE: It is extremely important that hydraulic system oil be absolutely clean and free from foreign matter. If unloading valve shows evidence of abrasive matter in system, complete system should be drained and refilled with clean oil.

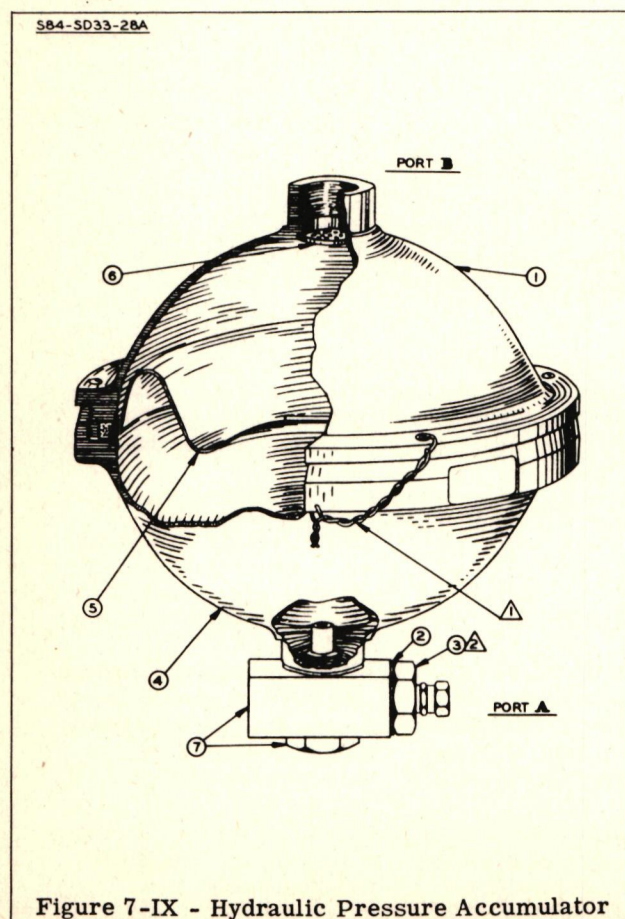


Figure 7-IX - Hydraulic Pressure Accumulator

PARTS LIST - HYDRAULIC PRESSURE ACCUMULATOR

Ref.	No.	Quan.	Item	Part No.
1	1		Oil Chamber	3X-63204
2	1		Gasket	B-47139
3	1		Air Fitting	B-47136
4	1		Air Chamber	3X-57156
5	1		Diaphragm	D-58289
6	1		Screen	B-58557
7	-		Tee Assembly (Ref.)	S84-SD33-19A.*

* Tee assembly not furnished as part of Vickers AA-14008-A accumulator assembly.

NOTES:

- ① Safety wire required as shown.
- ② Compressed air connection (charge with dry compressed air to required pre-load pressure). Condensate may be drained prior to periodic recharging by depressing air valve stem after oil system pressure is relieved.

j. Hydraulic Pressure Accumulator.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Cannot keep air out of system. Air pressure gage shows loss of air pressure.	(a) Holes in accumulator diaphragm caused by metal particles becoming trapped around joint of diaphragm and accumulator parting surface.	1. Replace diaphragm.

NOTE: At 100-hour inspection, accumulator will be disassembled and diaphragm will be carefully inspected for pin holes at above mentioned point.

(2) No air pressure. No air in system.	(a) Small hole or crack in lower half of accumulator.	1. Replace accumulator.
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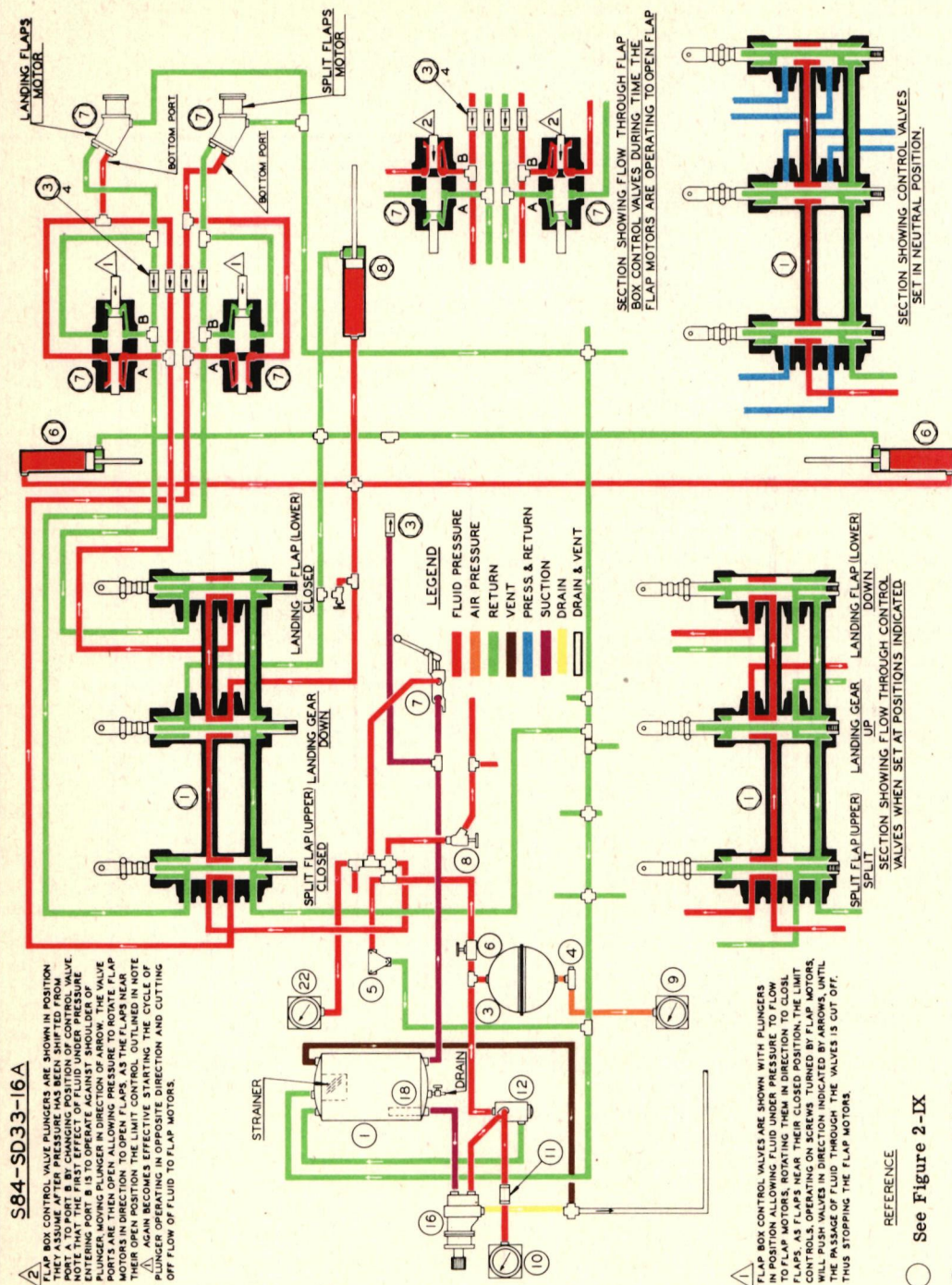
k. Accumulator Charging Valve.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Engine pump running. Pressure above 1000 pounds per square inch on both hydraulic pressure gages.	(a) Bypass valve in pressure regulator stuck in "CLOSED" position.	1. Refer to above. Pressure regulator not unloading.
(2) Engine pump running. 90 pounds per square inch on hydraulic gage at floor board. 450 pounds per square inch on air pressure gage at floor board. No pressure on hydraulic gage on instrument panel.	(a) Accumulator charging valve dirty.	1. Disassemble and clean accumulator charging valve. Carefully check bleeder orifices. Lap check valve on seat with No. 500 carborundum or Minnesota Mining lapping compound. After assembly, install pressure gage on accumulator side of accumulator charging valve. Build 1000 pounds per square inch pressure with emergency hand pump. There must be no leak. (Be sure the hand control is not set to charge accumulator during this test.)

l. Emergency Hydraulic Hand Pump.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Cannot build or maintain pressure with hand pump.	(a) Valves dirty or corroded.	1. Lap valves to seats with No. 500 lapping compound. After assembly, install pressure gage on pressure outlet. It should be possible to build 1350 pounds per square inch pressure with four full strokes of pump.

NOTE: In this discussion of the hydraulic system, it will be necessary to refer to the travel of hydraulic fluid through the various units, especially in trouble shooting and check-out procedure. The words "ahead" and "behind" will be used as follows:



EXAMPLE: In order to check the accumulator charging valve, item 6, fig. 1-IX, disconnect the line "ahead" of the valve; operate the emergency hand pump slowly; there should be no leak at valve.

In other words, by referring to "ahead" of a unit, we mean that side on which the fluid enters the unit. By "behind" the unit, we mean that side on which the fluid leaves the unit.

2. Landing Gear Hydraulic System.

a. Description.- The landing gear hydraulic system is arbitrarily limited in this discussion to include only that portion of the hydraulic system which extends and retracts the landing gear and tail wheel. The hydraulic brake system is treated as a separate division of the hydraulic system, and the hydraulic features of the landing gear and tail wheel shock struts are discussed under these respective items.

Each half of the main landing gear hydraulic system operates in the same manner from one control. The tail wheel hydraulic system also operates simultaneously from the same control.

The combined landing gear and tail wheel hydraulic system consists essentially of a portion of the landing gear and flap selector valve, two landing gear retracting struts, a tail wheel retracting strut, an emergency bypass valve, and the necessary lines and fittings. The installation is shown in perspective on fig. 2-IX, and in schematic form on fig. 1-IX.

The two lines from the selector valve extend downward into the center panel, forward of the main wing beam, to fittings. Three branches of each line then extend respectively to the two landing gear retracting struts and the tail wheel retracting strut. Lines that connect directly to the landing gear retracting struts are flexible; the remainder of the lines are rigid.

Each landing gear retracting strut is located within the center panel structure above the respective landing gear units. The body of the strut pivots to the structure, while the piston rod extends inboard and attaches to a cross-pin in the locking pin piston. This piston, in turn, is housed in a slotted cylinder which forms the top inboard portion of the landing gear drag truss. Extension of the piston extends the landing gear.

The tail wheel retracting strut is rigidly attached to the fuselage structure in a position nearly parallel to the thrust line and forward of the remainder of the tail wheel retracting mechanism. The piston of the retracting strut extends aft and connects to the actuator of a lock assembly, a mating portion of which is, in turn, attached to the upper end of the tail wheel shock strut. The lock assembly is arranged so that it may be moved in a fore and aft direction by the retracting strut piston, along a round supporting guide, to retract or extend the tail wheel gear, and lock it in position when extended. Extension of the piston extends the tail wheel gear and locks it in full "DOWN" position.

b. Normal Operation.- A complete description of the mechanical action involved in extending and retracting the landing gear and tail wheel is given in section V. The operation described below will be confined primarily to the hydraulic action involved. Refer to fig. 2-IX for location and arrangement of the hydraulic units. Refer to the schematic fig. 1-IX to trace the flow as described herein.

(1) Extension of the Landing Gear and Tail Wheel.- Referring to fig. 8-IX, note that the selector valve detail at the top of the drawing shows the landing gear plunger in the landing gear "DOWN" position. As the selector valve lever is moved to place the plunger in this position, the mechanical "UP" latch is released. With the plunger then in the position shown, fluid under pressure from the main hydraulic system is directed through lines to the outboard ports of the landing gear retracting struts and to the forward port of the tail wheel retracting strut. The pistons of the three struts are thereby extended as shown on the schematic to extend the landing gear and tail wheel. The landing gear units automatically lock in the full "DOWN" position by a mechanical arrangement. Each retracting strut piston is, however, connected to the locking pin to insure positive locking of the gear when the full "DOWN" position is attained. The last one-half inch of travel of the piston of the tail wheel retracting strut to the extended position operates the sleeve of a lock assembly to lock the assembly to the guide. Also, as long as the piston is within one-half inch of the extended position, the lock will not release, and external loads tending to collapse the tail wheel gear will be transmitted through the lock assem-

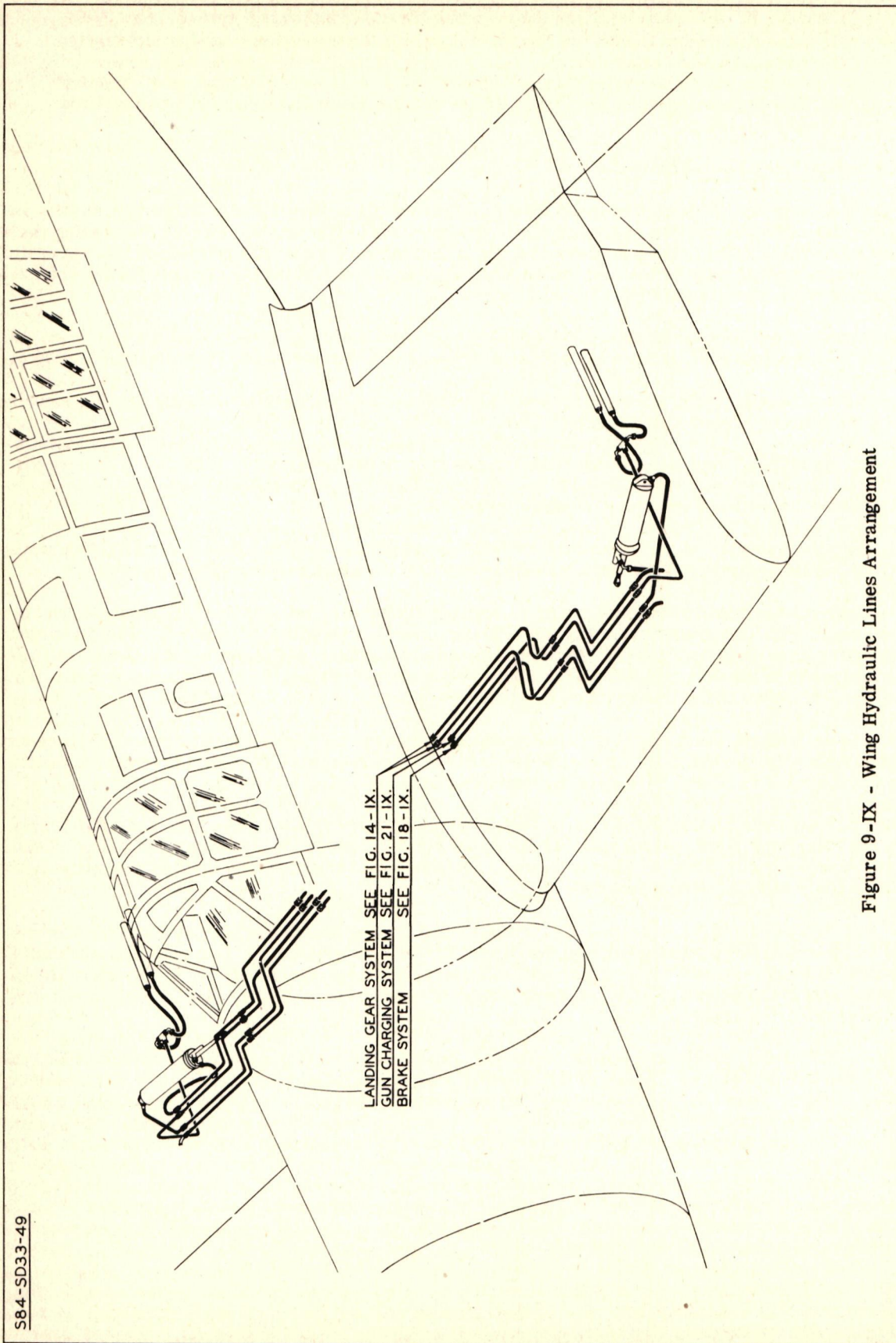


Figure 9-IX - Wing Hydraulic Lines Arrangement

bly to the guide and not to the retracting strut piston. The retracting strut incorporates a spring-loaded mechanism (described hereafter) to insure that the piston will be retained in the fully extended position against vibration or extraneous loads, without hydraulic pressure, but will retract readily under hydraulic pressure. Therefore, once the tail wheel is extended to the locked "DOWN" position, hydraulic pressure is not required to maintain it in that position.

(2) Retraction of the Landing Gear and Tail Wheel.- Referring to the schematic drawing, fig. 2-IX, note that the selector valve detail at the bottom of the drawing shows the landing gear plunger in the landing gear "UP" position. Placed in this position, fluid under pressure from the main hydraulic system is directed through lines to the inboard ports of the landing gear retracting struts, and to the aft port of the tail wheel retracting strut. The pistons of the three struts begin to retract. The initial retracting of the pistons of the landing gear retracting struts pulls the spring-loaded pins to unlock the landing gear from the "DOWN" position. When the locking pins are fully retracted, further retraction of the strut pistons retracts the landing gear. As the landing gear attains the fully retracted position, a projection on each strut engages a mechanical latch which positively locks the gear in the retracted position. The initial retraction of the piston of the tail wheel retracting strut overcomes the spring retainer within the strut and at the same time moves the sleeve of the tail wheel lock assembly forward to release the lock. Further retraction of the strut piston moves the entire lock assembly forward along the guide to retract the tail wheel.

c. Emergency Operation.- Emergency operation of the landing gear and tail wheel with hydraulic pressure is essentially the same as normal operation except that pressure is developed by operation of the hydraulic hand pump.

This procedure is also recommended for checking the operation of the landing gear and tail wheel system following any repairs or adjustments involving the retracting mechanism.

Extension of the landing gear without hydraulic pressure may be accomplished in flight by placing the selector valve in the "DOWN" position to release the "UP" latches, then opening the bypass valve (item 2, fig. 1-IX) to allow a free flow of fluid from the inboard ports to the outboard ports of the retracting cylinders. The weight of the gear units should normally swing them to the fully extended position and, if the "DOWN" locks do not readily engage, a slight "rocking" of the airplane from side to side by the pilot should result in positive locking. The tail wheel, however, will not normally lock "DOWN" when extended by its own weight, since overtravel of the retracting strut piston is required to place the locking mechanism in the locked position.

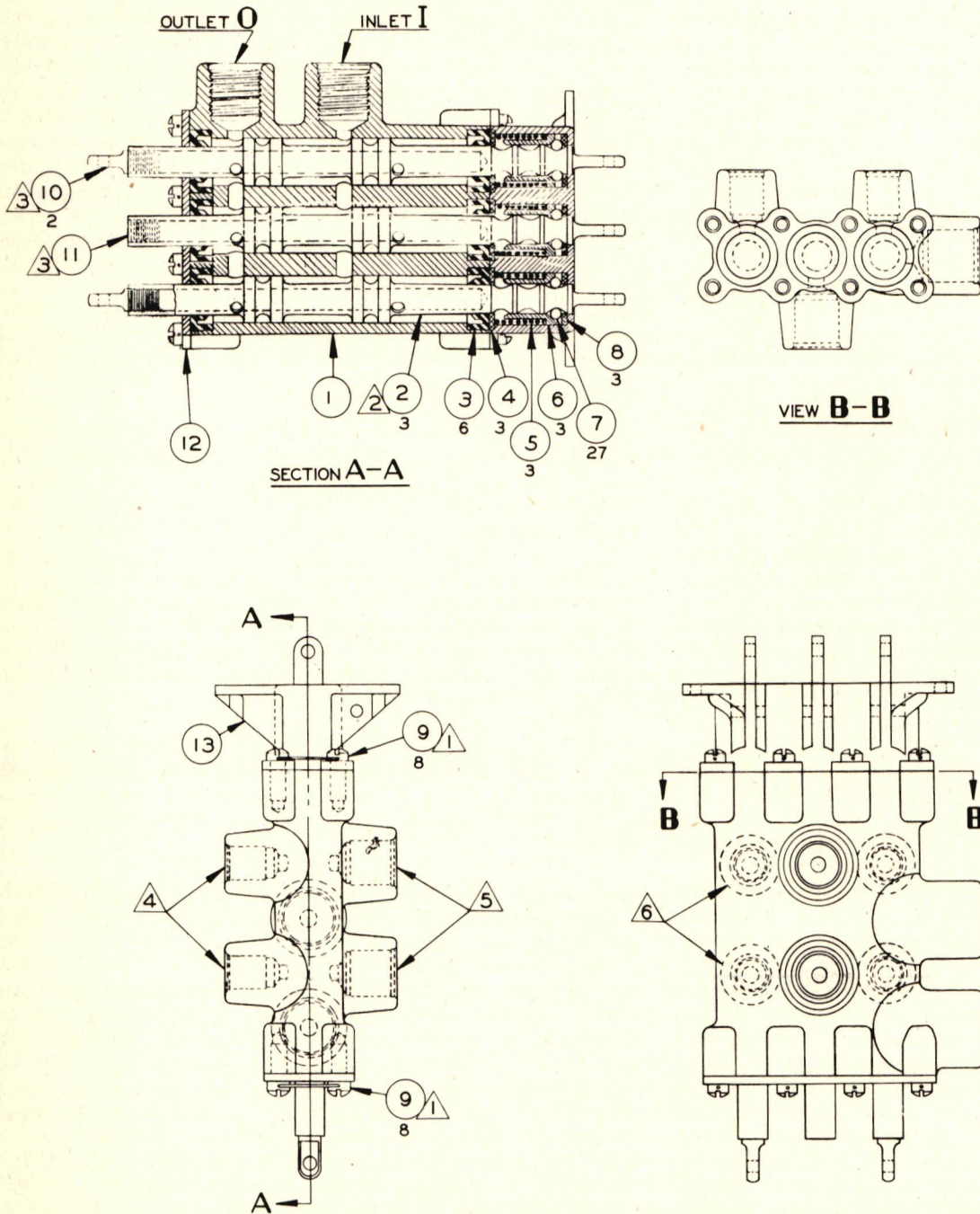
d. Selector Valve.-

(1) Description.- Figure 10-IX is a detail of the combination landing gear and flap selector valve. The landing gear portions of the two valves are the same, the difference being in the flap portions which provide control of the motor-operated flaps. For convenience, the following discussion is referred to fig. 8-1X.

The principal parts of this valve assembly are the body and three identical plungers. The center plunger controls fluid to the landing gear and tail wheel retracting struts, while the two outer plungers control fluid to the respective flap motors.

Passages are drilled from the inlet and outlet ports through the three plunger cylinders to provide fluid supply and return. Note that the plungers are hollow, with plugged ends, and are each drilled at two points to allow fluid passage through the hollow portion. Spring-loaded balls engage three grooves at the top of each plunger to properly position each plunger as it is operated by attached levers (not shown). The center position of the landing gear plunger, however, is meaningless, since there is no "NEUTRAL" position for this plunger, and operation of the control lever to the "UP" or "DOWN" position moves the plunger past the center position. The center groove is left in the plunger for the landing gear merely to standardize parts. Cup-type seals are provided around each end of the plungers at the ends of the cylinders. Flow of fluid through the valve is most easily traced by operating the dummy cardboard valve included elsewhere in this Handbook, appendix 1.

(2) Disassembly, Minor Repairs, and Assembly.- Disassembly procedure should be obvious from fig. 8-IX. However, the following sequence is recommended to replace packing. Remove lock wire and eight screws that attach the head (13) to the body (1). This will free the



(PART OF C.W. ASSEMBLY NO. S84-33-502)

Figure 10-IX - Landing Gear and Flap Selector Valve

PARTS LIST - LANDING GEAR AND FLAP SELECTOR VALVE

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Body	S84-33-518
2	3	Plunger	S84-33-414
3	6	Packing Cup	1145-D-.531
4	3	Washer	S84-33-429-1
5	3	Spring	S84-33-411
6	3	Sleeve	S84-33-415
7	27	Steel Ball	5/32 Dia. -Common Steel Balls
8	3	Washer	S84-33-429-2
9	16	Screw	AN503-416-10
10	2	Plug - Eye End	S84-33-653
11	1	Plug	S84-33-149
12	1	End	S84-33-164
13	1	Head	S84-33-409

NOTES:

- ① Lock wire required as shown.
- ② Clearance between plungers and body minimum .0001 - maximum .0002.
- ③ Sweat in place.
- ④ Split flap-cylinder connections.
- ⑤ Landing gear cylinder connections.
- ⑥ Landing flap connections.

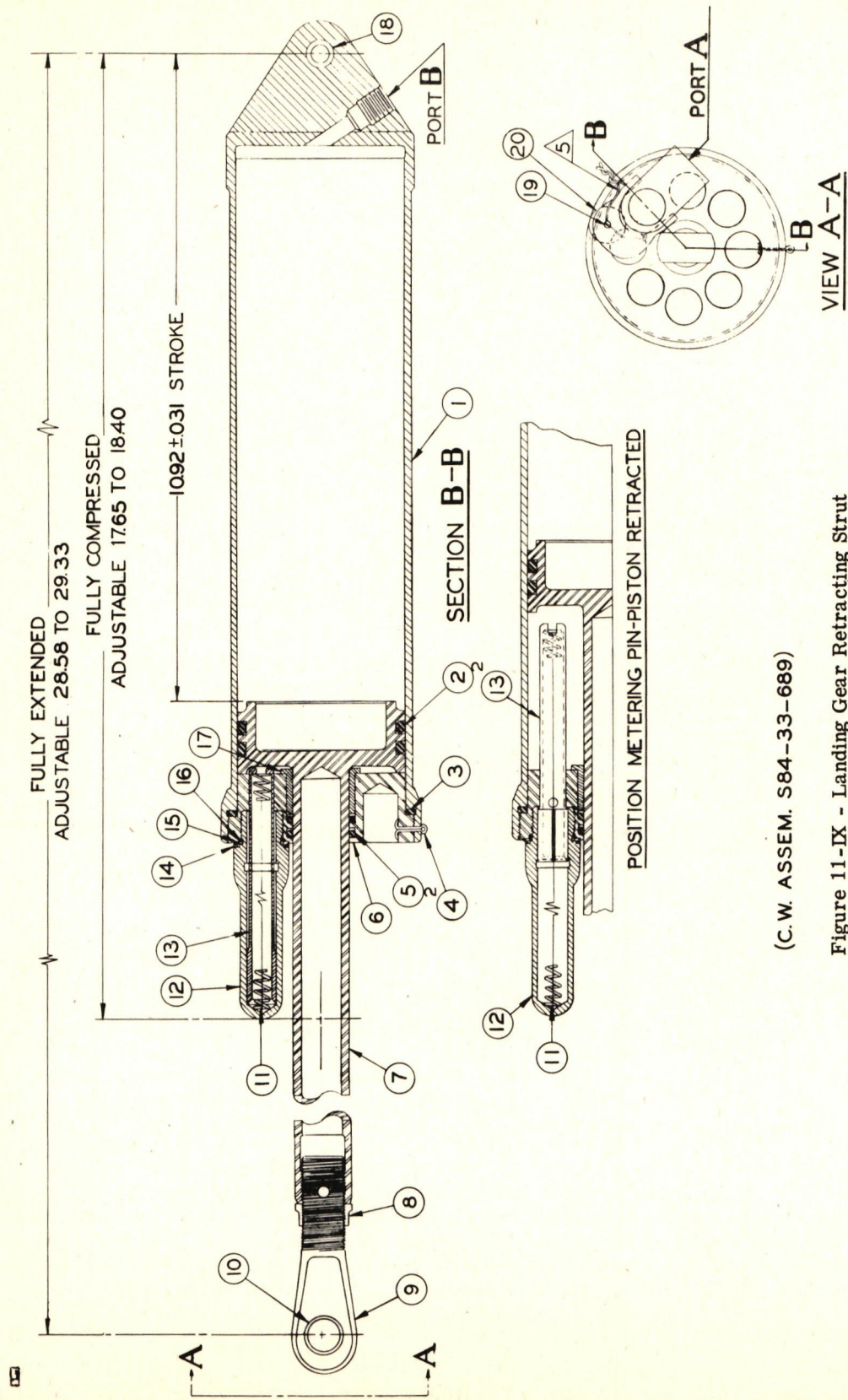
springs (5), the sleeves (6), and the balls (7). Remove the head (13) and all contained items. Remove the washer (4). Remove the lock wire and eight screws that attach the plate (12) to the bottom of the body, and remove the plate. Packing cups should be easily dislodged by withdrawing the plungers. Before removing any plunger from the body, tag it so that it can be re-assembled in its original position. Handle plungers with extreme care.

Clean and dry all parts thoroughly before reassembly. Lubricate seals and plungers thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing. Note that nine balls (7) are required for each plunger.

e. Landing Gear Retracting Strut.-

(1) Description.- Figure 11-IX is a detail of the landing gear retracting strut. Two identical struts are required. The strut is conventional except for the metering tube arrangement incorporated in the cap assembly. The purpose of the metering tube is to impede the flow of fluid from the cylinder during the last 2-3/4 inches (approximate) of piston travel to the extended position. This action, in turn, slows and cushions the final portion of the landing gear travel to the "DOWN" position. Refer to the view showing the piston in the partially retracted position, and note that in this position fluid may flow freely through the metering tube (13) and out through port "A." However, when the piston extends, it contacts the inner end of the tube (13) and carries it into the metering body (12), forcing the free end past port "A." During the next inch of travel, all fluid-flow out to port "A" is metered by the slot in the head of the metering tube. During the remainder of the travel to the fully extended position, all fluid-flow out of port "A" is metered by the hole drilled in the side of the metering tube. It should be noted also that flow impedance is obtained during a corresponding interval at the beginning of retraction, but this condition is incidental and not the purpose of the snubber. The metering tube (13) is spring-loaded so that it must be actuated by the piston (7) to obtain metering action.

(2) Disassembly, Minor Repair, and Assembly.- Refer to fig. 11-IX for construction details of the landing gear retracting strut. Replacement of any of the seals or packing requires re-



(C.W. ASSEM. S84-33-689)

Figure 11-IX - Landing Gear Retracting Strut

PARTS LIST - LANDING GEAR RETRACTING STRUT

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Cylinder	S84-33-601-1
2	2	Packing	AN6227-40
3	1	Packing	AN6230-15
4	1	Cotter Pin	AN380-C3-3
5	2	Packing	AN6227-21
6	1	Cylinder Cap	S84-33-817
7	1	Piston	S84-33-533
8	1	Nut	S84-33-605
9	1	End	S84-33-604-1
10	1	Bushing	1001-D-10-.620
11	1	Spring	S84-33-935
12	1	Body Metering Valve	S84-33-934
13	1	Metering Pin	S84-33-937
14	1	Lock	S84-33-869
15	1	Shim	1075-DJ-.062- .875-1.062
16	1	Gasket	AN902-16
17	1	Retainer	S84-33-715
18	1	Bushing	1001-D-7-.718
19	1	Screw	AN503-8-6
20	1	Spacer	1075-DN-.125- .177-.500

NOTES:

1. Drill hole for cotter pin after parts are assembled.
2. Screw cap flush with end of cylinder.
3. Test procedure:
 - A. Apply 1500 pounds per square inch to port "A." Leakage past piston shall not exceed five drops per minute. There shall be no external leakage.
 - B. Use same procedure on port "B."
4. Use hydraulic fluid, Specification No. AN-VV-O-366a.

 Lock wire as shown.

removal of the cylinder cap assembly (6). To remove the cap assembly, first remove the cotter pin (4), then unscrew the cap assembly (6) and withdraw the piston from the strut body. At this stage only the main piston seals (2) and the cap assembly packing (3) may be replaced. To replace the piston rod seals (5) or the metering body gasket (14), it is necessary to remove the lock nut and end fitting (8 and 9) from the piston rod, and withdraw the piston rod from the cap assembly (6). Also, before the metering body (12) can be unscrewed, it is necessary to remove the lock wire and screw.

It is recommended that the extended or retracted strut length be accurately measured before disassembly of the lock nut and end fitting (8 and 9), so that proper adjustment can be obtained at reassembly.

Before installing new packing or seals, remove all traces of old packing or seals, clean parts thoroughly, and allow to dry. Lubricate all seals or packing thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing. When installing piston rod seals (5), exercise care in inserting the piston rod through the cap and seals. When assembling threaded parts, use ample approved anti-seize compound, Specification No. AN-C-53.

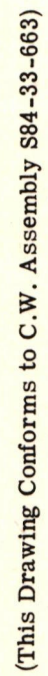


Figure 12-IX - Tail Wheel Retracting Strut

PARTS LIST - TAIL WHEEL RETRACTING STRUT

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Cylinder	S84-33-576
2	1	Packing	AN-6227-23
3	1	Cap	S84-33-659
4	1	Piston	S84-33-620
5	1	Washer	S84-33-581
6	1	Packing	AN6227-11
7	1	Nut	S84-33-660
8	1	Rod Assembly	S84-33-656
9	1	Packing	AN-6227-27
10	1	Spring	S84-33-580
11	1	Ring	S84-33-082
12	2	Packing	AN-6227-19

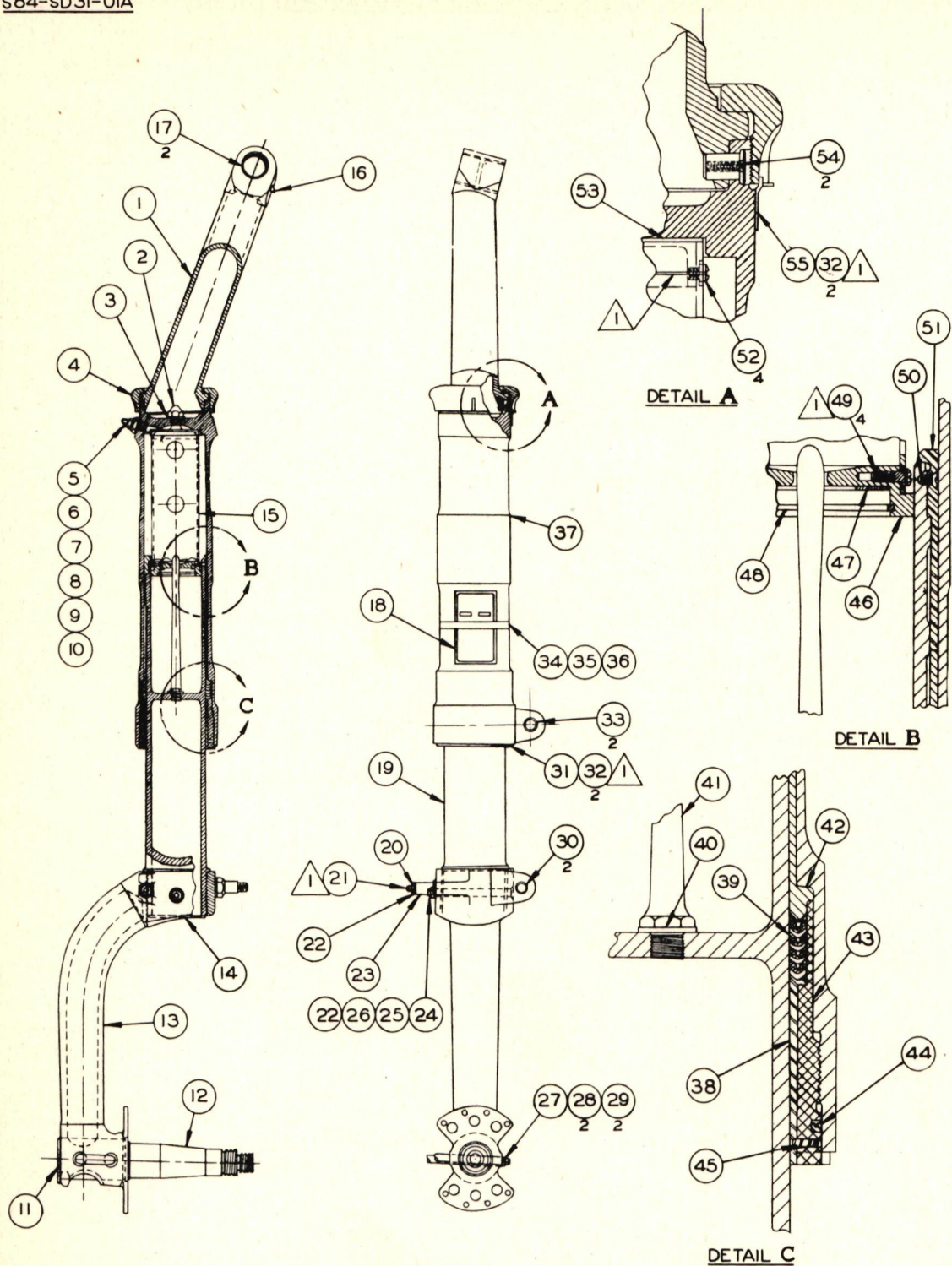
NOTES:

- ① Lock wire required as shown.
2. Bursting test: - Apply 2500 pounds per square inch to ports "A" and "B" simultaneously.
3. Apply 1500 pounds per square inch pressure to port "A." Leakage past piston shall not exceed five drops per minute. There shall be no external leakage.
4. Apply 1500 pounds per square inch pressure to port "B." Leakage past piston shall not exceed five drops per minute. There shall be no external leakage.
5. After testing, drain and cap ports.
6. For additional testing information, see Curtiss Specification No. S-345.
7. Strut must be free from dirt and chips.

f. Tail Wheel Retracting Strut.-

(1) Description.- Figure 12-IX is a detail drawing of the tail wheel retracting strut. The strut is conventional except for a spring arrangement in the retaining nut in the aft end of the cylinder to retain the piston in the fully extended position. This provision, in turn, insures that the extended piston will maintain the tail wheel "DOWN" lock assembly in the locked position, until hydraulic pressure is applied to retract the piston in the normal manner. The arrangement consists of an eight-tined annular spring with internal projections, which engage a washer extending outward from the surface of the piston rod. The retaining properties of the spring are effective in preventing movement of the piston toward the retracted position under vibration or extraneous loads, but are readily overcome by application of hydraulic pressure to retract the strut.

(2) Disassembly, Minor Repair, and Assembly.- Refer to fig. 12-IX for construction details of the tail wheel retracting strut. Replacement of the piston seals, retainer spring, or aft nut packing requires the removal of the retaining nut (7). Replacement of the forward nut packing obviously requires removal of the retaining nut (3). To replace the piston rod packing (6) or the spring (10), first remove the retaining nut (7). The lock ring (11) must also be removed to replace the spring (10). Remove the piston from the cylinder to replace the main piston seals (12). Before installing new packing or seals, remove all traces of old packing or seals, clean parts thoroughly, and allow to dry. Lubricate all seals or packing thoroughly with hydraulic fluid, Specification No. AN-VV-0-366a, before installing. When assembling threaded parts, use ample approved anti-seize compound, Specification No. AN-C-53.



(C. W. ASSEM. S84-31-910)

Figure 13-IX - Landing Gear Shock Strut

PARTS LIST - LANDING GEAR SHOCK STRUT

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1L or 1R	Cap Strut	S84-31-517
2	1	Nut	S84-31-032
3	1	Washer - Specification	1075-DE-.064-.687-1.250
4	1	Cap Strut Collar	S84-31-525
5	1	Washer-Specification	1075-DE-.064-.781-1.062
6	1	Adapter	S84-31-044
7	1	Washer-Specification	1075-DE-.064-.515-.750
8	1	Cap	53083 (Bendix)
9	1	Plug	53084 (Bendix)
10	1	Core	100DBB (Dill)
11	1	Cap	S84-31-600
12	1	Axle	S84-31-938
13	1L or 1R	Yoke	S84-31-914
14	1	Cap	S84-31-601
15	1	Tube	S84-31-528
16	1	Lubricator	#1641 (Alemite)
17	2	Bushing	S84-31-540
18	1	Instruction Plate	S84-31-563
19	1	Piston	S84-31-512
20	1	Self-lock Nut	AN364-820
21	1	Roller Pin	S84-31-541
22	2	Washer	AN960-816
23	1	Roller	1001-D-12-1.343
24	1	Nut	AN320-8
25	1	Cotter Pin	AN380-3-4
26	1	Bolt	1108-DS-60
27	1	Towing Ring	S84-31-539
28	2	Nut	AN310-8
29	2	Cotter Pin	AN380-3C-3
30	2	Bushing	1001-D-12-.490
31	1	Lock Tab Bearing	S84-31-565
32	4	Screw	AN502-10-6
33	2	Bushing	1001-D-16-.910
34	1	Clamp	S82-31-336-82
35	1	Screw	AN515-8-7
36	1	Nut	NAF1127-.832
37	1L or 1R	Cylinder	S84-31-516
38	1	Bearing	S84-31-521
39	1	Packing	S84-31-036
40	1	Lock Washer	1075-DE-.064-.640-.875
41	1	Metering Pin	S84-31-537
42	1	Spacer	S84-31-607
43	1	Nut	S84-31-520
44	1	Hydraulic Packing Cup	914-D-5.260A
45	1	Rod	S84-31-544-1
46	1	Head	S84-31-530
47	1	Washer	S84-31-026
48	1	Snap Ring	S84-31-035
49	4	Screw	AN502-10-8
50	1	Screw	AN510-10-6
51	1	Up-Bearing	S84-31-022
52	4	Screw	AN502-10-4
53	1	Cap	S84-31-529
54	2	Cap Strut Pin	S84-31-531
55	1	Cap Nut Lock Tab	S84-31-564

NOTES:

1. Lock wire required as shown.
 2. A pressure of 1850 pounds per square inch shall be applied to the oleo assembly and held for 15 minutes.
 3. With the strut in vertical position, a pressure of 250 pounds per square inch shall be applied and held for four hours.
 4. With the strut in horizontal position, a pressure of 250 pounds per square inch shall be applied and held for four hours.
 5. The strut shall be operated continuously for one hour, but the number of cycles of operation shall not be less than 500.
-

g. Landing Gear Shock Strut.-

NOTE: The shock struts are designed to perform the following necessary functions during the landing of the airplane:

1. Absorption of Impact Energy.- The impact energy of the landing airplane is absorbed by the strut fluid and by the compression of the air in the upper chamber during the compression stroke.

2. Absorption of Taxiing Loads.- The loads developed on the struts while the airplane is taxiing are carried by the compressed air in the upper chamber of the strut.

3. Snubbing.- Snubbing effect, which is necessary to prevent quick rebounds, is precluded by forcing the strut fluid to pass through restrictions on the expansion stroke of the strut. The shock struts will be serviced with hydraulic fluid, AAF-3580, medium grade. It will be noted that the above instruction supersedes that specifying AN-VV-O-366a, hydraulic fluid, for use in shock struts.

Always inflate strut according to instructions stamped on strut name plate.

(1) Disassembly, Packing Installation, and Assembly.- To disassemble the landing gear shock strut, remove and install packing and reassemble the strut, refer to fig. 13-IX, and proceed as follows:

- (a) Jack airplane clear of the ground using procedure specified in section VII.
- (b) Remove the air valve cap and deflate the strut.
- (c) Remove the lock wire, two screws, and serrated lock (28 and 47) at the bottom of the cylinder to unlock the packing gland nut.

(d) Using spanner wrench (S84-88-538) supplied with the airplane, unscrew the packing gland nut at the bottom of the cylinder and withdraw the piston as described in section IX.

(e) Have large, clean receptacle at hand to catch hydraulic fluid when piston is removed.

(f) Remove the flathead locking screw (33) from the top of the piston and unscrew the top outer bearing (34).

(g) Remove the center spacer (42) thus freed.

(h) Remove the gland nut and packing assembly (38, 41, 43, 44, and 45).

(i) Remove the packing (41 and 44) from the gland nut assembly.

(j) Clean the gland nut assembly and packing adaptors thoroughly to remove any particles of old packing.

(k) Re-install the gland nut assembly on the piston.

(l) Lubricate new packing (41) thoroughly with AAF-3580 (or AN-VV-O-366a) hydraulic fluid and install. Work the packing carefully down into the recess formed by the packing gland nut and the piston.

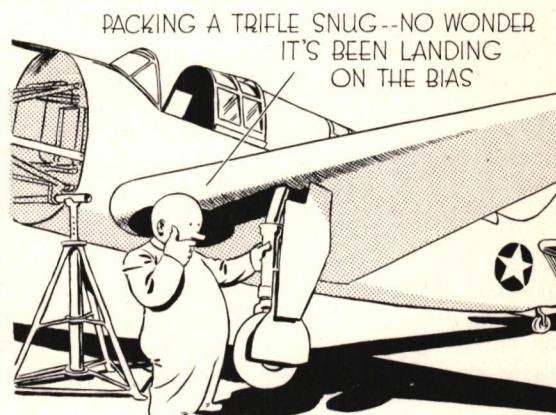
(m) Tighten packing nut to determine if there is some adjustment left after packing and spacers are snug. Back nut off packing to relieve tension.

(n) Re-install all other parts in the reverse order of their removal.

(o) Adjust packing nut.

(p) The removal and installation of the seal (44) near the lower rim of the packing gland nut requires no special procedure.

(q) Before servicing shock strut, place a jack under fork and collapse shock strut. Back the jack down gradually and watch the strut for drag. The packing must be tight enough to hold hydraulic fluid yet not tight enough to drag. This is very important as failure of one or both struts to extend properly on take-off or landing may cause the airplane to turn over.



(r) If means are available, the strut should be "run in" after replacing the packing. This should be done on a machine which will move the piston in and out through at least half its total travel, minimum of 500 cycles. The strut should be fully serviced with hydraulic fluid Specification No. AAF-3580, medium grade, and air before running in (see T. O. 06-1-2).

(s) Shock Strut Service. - To check the fluid level, proceed as follows:

Deflate the strut by backing off the filler plug slightly and allowing the air to escape slowly past the copper gasket at the plug seat. This will prevent damage to the valve core caused by the sudden rush of high pressure air past its seat. Do not attempt to remove filler plug without first completely deflating the strut in this manner.

Back off the filler plug slightly, until all "fizzing" of air and fluid ceases.

Remove the filler plug and check the fluid level, which should be flush with the filler plug hole when the strut is fully collapsed and the airplane is in normal taxiing position.

Use only Specification No. AAF-3580, medium grade, hydraulic fluid.

Fill strut through the filler hole until it overflows with strut fully collapsed and vertical.

Insert the filler plug loosely and extend and collapse the strut several times in a vertical position to eliminate trapped air.

Remove the filler plug and check the fluid level with the strut fully collapsed. Add fluid to overflowing if required.

Replace the washer and filler plug. It is recommended that a new washer be used, if available, to avoid leaks. Exercise care in replacing plug to avoid damage to threads and valve.

Inflate the strut with air as specified on the strut name plate.

Rock the airplane while inflating, so that the strut will alternately extend and compress, to overcome packing friction. When fully inflated, all the struts must have the proper extension, as specified on strut name plate.

Any checking or adjusting of strut inflation should be done on a reasonably level surface, sheltered from the wind, with the airplane in taxiing position and fully loaded. Be sure that the struts have been extended and compressed several times before any checking or adjusting is attempted.

The air valves are similar in design and function to those used in automobile tires; however, they are especially designed for use in air-oil type shock absorbers, employing special composition seat material instead of rubber. When making replacements, be sure to obtain valve cores for air-oil shock absorbers and not ordinary tire valve cores. The shock absorber cores are procured and stocked as cores, valve inside, Schrader Part No. 7533 or Dill Part No. 100 DBB-class 29.

After inflation, test the valve, the valve core, and the filler plug carefully for leaks by using soapy water. Usually leaks around the filler plug, valve, or other parts will be evident by a seepage of fluid.

Small amounts of air can be removed from the strut by depressing the valve core, provided that extreme care is used to allow the air to escape slowly, to avoid damage to the valve seat. This can be accomplished by supporting the tool, used to depress the core, against the lip of the valve stem.

Care should be exercised to prevent damaging the filler plug and air valve assembly by excessive tightening of the air hose connection, by improper use of tools, or by using the filler plug as a stop for hoist attachment or hitch. When using the plug, if leakage at the hose connection to the air valve cannot be stopped by hand tightening, the fitting gasket, Bendix Part No. 53025, should be replaced. Wrenches or pliers will not be used on this connection.

In case of leakage at the packing gland, as evidenced by fluid seepage or by air bubbles when soapy water is applied, the packing nut should be tightened firmly but not excessively. Before tightening, however, the air pressure must first be released from the strut as the packing cannot be tightened properly under pressure. If normal tightening will not stop the leakage, the packing must be replaced. Whenever this becomes necessary, the piston tube should be carefully inspected for excessive scoring, roughness, or an out of round or bent condition.

h. Trouble Shooting the Landing Gear, Landing and Diving Flaps, and Brake Hydraulic System. -

(1) Landing Gear Selector Valve and Retracting Strut

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(a) Cannot shift selector valve handle.	1. Spring-loaded balls (7) or plunger (2) dirty, corroded, or broken. Spring (5) or sleeve (6) broken or damaged. (See fig. 10-IX.)	a. Inspect by removing head (13). Replace balls, spring, or sleeve. Remove burs from plunger. <u>Do not break corners</u> . Lap to satin finish.

- | | | |
|---|--|--|
| (b) Leak at plunger. | 1. Faulty washers or scored plunger. | a. Replace washers, lap plunger to satin finish. |
| (c) Pressure normal at pump, cannot retract landing gear. | 1. Leak past plunger in selector valve.
Internal leak in retracting strut.
Leak at packing nuts. | a. Check body carefully for scored walls. Treat plunger as described at b. above.
Cylinder scored or packing rings defective. Hone or replace cylinders. Install new packing rings.
Replace packing. |

i. Wheels. - The wheels of the main landing gear are of the following sizes. Units No. 1 through No. 849 are equipped with Goodyear 34 x 9 wheels assembly No. 530244M and Goodyear Brakes, 12.7 x .100/.125 x 7 HP, assembly No. 510944M. Units No. 850 and up are equipped with Goodyear 34 x 9.9 wheels, assembly No. 530660M and Goodyear Brakes 12.7 x .155/.094 x 7HP, assembly No. 511415M. The brakes will be described separately under (7) following.

(1) Removal, Installation, and Adjustment. - To remove the wheel, proceed as follows:

- (a) Raise the landing gear by hoist or jacks, until the wheel clears the ground.
- (b) Remove wheel cover.
- (c) Remove lock ring; then remove hub cap.
- (d) Remove cotter pin, nut, washer, and collar.
- (e) Remove the wheel.

To install the wheel, reverse the above procedure with the following additions:

- (f) Before installing the wheel, see that the brake is completely installed and properly adjusted.
- (g) Line up the keys on the bronze discs of the brake with a straight-edge and apply the brake to hold the discs in position.
- (h) Replace with new parts any felt grease retainers that have become soaked with grease.
- (i) Lubricate the wheel bearings as specified in section XIX and install the wheel, making sure that the keyways in the wheel properly engage the keys on the bronze discs.
- (j) Install the collar, washer, and nut on the axle.
- (k) Release the brake.
- (l) Tighten the nut until the wheel binds and will not turn freely; then back off one hole on the nut and install a new cotter pin. Check to see that the wheel turns freely. Replace hub cap, lock ring, and cover.

NOTE: Do not install wheels that are corroded on the inside. If finish only has chipped off wheel, refinish immediately as follows:

Portions of the wheel where the original finish has peeled or chipped should be re-touched using lacquer, cellulose nitrate (clear and pigmented), Specification No. AN-TT-L-51. One or two coats should be used, depending on the condition of the old paint. If it is necessary to completely refinish the surface, one coat of primer, metal zinc chromate, Specification No. AN-TT-P-656a, followed by two coats of the lacquer, Specification No. AN-TT-L-51, should be applied. It is essential that the surface be thoroughly cleaned before the application of the primer. The old finish should be removed with acetone, Specification No. 0-A51A.

j. Tail Wheel Shock Strut.-

(1) Disassembly, Packing Installation, and Assembly.- To disassemble the tail wheel shock strut, remove and install packing and reassemble the strut, proceed as follows:

- (a) Remove the air valve cap and deflate the strut.
- (b) Remove the air valve and drain the fluid from the strut.
- (c) To replace head seal (30), loosen lock nut (15); then unscrew and remove head (14). Refer to reassembly notes following before installing new seal.
- (d) To replace piston packing, first remove lock wire and unscrew gland nut (6).
- (e) Remove piston (7) from cylinder (1).
- (f) Remove lock screw (34) and unscrew bearing (28).
- (g) Remove seat adapter (29), then packing assembly (35 and 36), then seal adapter (32).
- (h) Remove the four brass separator rings (36) from the five packing rings (35).

Reassemble parts in reverse order, observing the following instructions:

- (i) Clean all particles of old seals or packing from metal parts.
- (j) Lubricate seals with clean hydraulic fluid, Specification No. AAF-3580 (or AN-VV-O-366a) before installation.
- (k) Install four brass separators between five packing rings, as shown in detail B of figure 4-V.
- (l) Be sure washer (33) is inside bearing (28) before installation of bearing.
- (m) When bearing (28) is tightened, if seals are loose, remove the bearing, both adapters and the seal assembly, and install washer 1075-DD-.032-1.156-1.593 between the adapter (32) and the collar (31) as per note 3 on drawing. Replace both adapters, the seal assembly, and the bearing (including washer). If seals are tight enough (see note 3), re-install lock screw (34).

- (n) Check the extended and compressed length of the assembled strut, and adjust head (14) as required to obtain correct length. Lock head (14) in correct position with lock nut (15).

(2) Shock Strut Service.- Fluid and air servicing procedure for the tail wheel shock strut is essentially the same as that for the main landing gear shock strut. Inflate the strut according to directions shown on the strut name plate.

NOTE: Service shock strut with hydraulic fluid, Specification No. AAF-3580, medium grade. (See T. O. No. 06-1-2.)

3. Flap Hydraulic System.

a. General.- The A-25A Airplane is equipped with double split flaps. For diving, both upper and lower flaps may be extended 25 degrees from neutral. For landing, the lower flap only may be extended 55 degrees from neutral. Operation of the flaps is accomplished by a combination hydraulic and mechanical arrangement, which is controlled by a selector valve located at the right side of the pilot's cockpit.

b. Flap System.-

(1) Description.- The flap hydraulic system comprises the flap selector valve, two hydraulic motors, and two automatically-operated valves for stopping the motors when the flaps attain

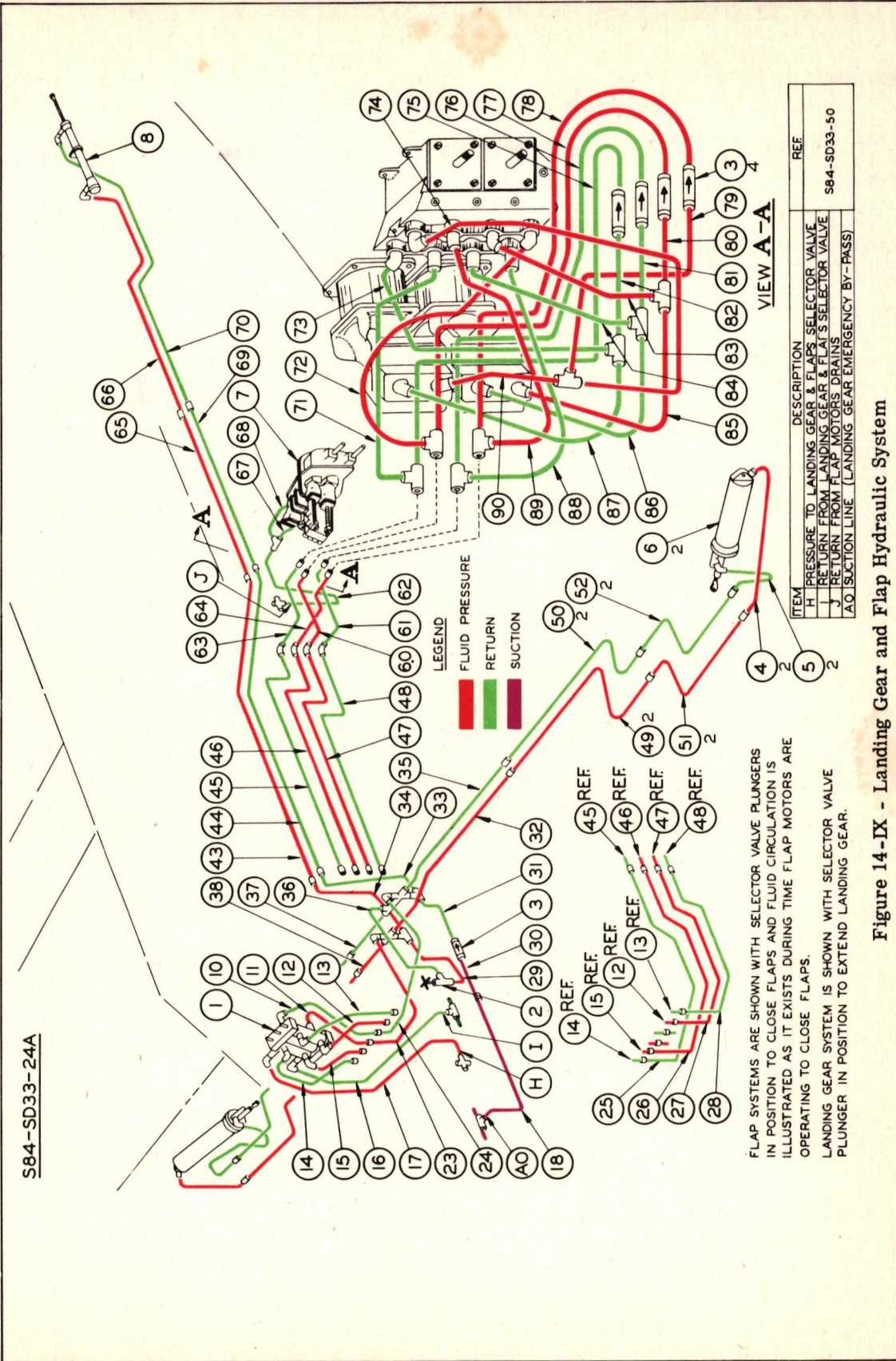


Figure 14-IX - Landing Gear and Flap Hydraulic System

PARTS LIST - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Selector Valve	S84-SD33-13
2	1	Bypass Valve	S84-33-598
3	5	Check Valve	Bendix 2207-A13
4	2	Hose Assembly	AN859-6-27
5	2	Hose Assembly	AN859-6-24
6	2	Hydraulic Strut	S84-SD33-7
7	1	Flap Control Unit	S84-SD33-37
8	1	Hydraulic Srut	S84-SD33-12



LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
10	S84-33-936-521	1	Pressure and Return Line from Selector Valve to Pilot's Floor	1/2 x .042	22.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D AN819-8 AN819-8 *
11	S84-33-936-520	1	Pressure and Return Line from Selector Valve to Pilot's Floor	1/2 x .042	21.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D AN819-8 AN819-8 *
12	S84-33-936-554	1	Pressure and Return Line from Selector Valve to Pilot's Floor	3/8 x .035	30.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
13	S84-33-936-555	1	Pressure and Return Line from Selector Valve to Pilot's Floor	3/8 x .035	32.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
14	S84-33-936-552	1	Pressure and Return Line from Selector Valve to Pilot's Floor	3/8 x .035	28.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
15	S84-33-936-553	1	Pressure and Return Line from Selector Valve to Pilot's Floor	3/8 x .035	28.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
16	S84-33-936-15	1	Return Line from Tee to Selector Valve	5/8 x .042	21.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *
17	S84-33-936-14	1	Pressure Line from Cross to Selector Valve	5/8 x .049	31.00	Alum. Al. 52SO WW-T-787	AN818-10D AN818-10D AN819-10 AN819-10 *
18	S84-33-936-94	1	Emergency Suction Line from Tee to Sta. 35.00	3/8 x .035	23.50	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
23	S84-33-938-53	1	Pressure and Return Line from Floor to Cross	1/2 x .042	15.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D AN819-8 AN819-8 *
24	S84-33-938-517	1	Pressure and Return Line from Pilot's Floor to Cross	1/2 x .042	15.00	Alum. Al. 52SO WW-T-787	AN818-8D AN818-8D AN819-8 AN819-8 *
25	S84-33-938-504	1	Pressure and Return Line from Pilot's Floor to Center Panel Support	3/8 x .035	15.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
26	S84-33-938-505	1	Pressure and Return Line from Pilot's Floor to Center Panel Support	3/8 x .035	15.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
27	S84-33-938-506	1	Pressure and Return Line from Pilot's Panel Support	3/8 x .035	15.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
28	S84-33-938-507	1	Pressure and Return from Pilot's Floor to Center Panel Support	3/8 x .035	15.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
29	S84-33-938-51	1	Pressure and Return Line from Bypass Valve to Tee	3/8 x .035	11.50	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
30	S84-33-938-61	1	Emergency Suction Line from Sta. 35.00 to Check Valve	3/8 x .035	13.75	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *
31	S84-33-938-50	1	Pressure and Return Line from Check Valve to Tee	3/8 x .035	24.50	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
32	S84-33-938-39	1	Pressure and Return Line from Cross to Center Panel (L.H.)	3/8 x .035	48.75	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
33	S84-33-938-9	1	Pressure and Return Line from Tee to Center Panel Support	3/8 x .035	12.75	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
34	S84-33-938-8	1	Pressure and Return Line from Tee to Center Panel Support	3/8 x .035	12.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
35	S84-33-938-40	1	Pressure and Return Line from Cross to Center Panel (L.H.)	3/8 x .035	47.12	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
36	S84-33-938-52	1	Pressure and Return Line from Bypass Valve to Tee	3/8 x .035	19.50	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
37	S84-33-938-60	1	Pressure and Return Line from Tee to Center Panel (R.H.)	3/8 x .035	10.25	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
38	S84-33-938-12	1	Pressure and Return Line from Cross to Center Panel (R.H.)	3/8 x .035	9.12	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
43	S84-33-930-17	1	Pressure and Return Line from Support S84-33-896 to Bulkhead Fitting	3/8 x .035	69.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *A* AN819-6 AN819-6 *
44	S84-33-930-18	1	Pressure and Return Line from Support S84-33-896 to Bulkhead	3/8 x .035	69.00	Alum. Al. 52SO WW-T-787	AN818-6D AN818-6D *A* AN819-6 AN819-6 *

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
45	S84-33-930-21	1	Pressure and Return Line from Support S84-33-896 to Support S84-33-889	3/8 x .035	61.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-6 AN819-6 *
46	S84-33-930-22	1	Pressure and Return Line from Support S84-33-896 to Support S84-33-889	3/8 x .035	62.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
47	S84-33-930-23	1	Pressure and Return Line from Support S84-33-889 to support S84-33-889	3/8 x .035	62.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
48	S84-33-930-24	1	Pressure and Return Line from Support S84-33-896 to Support S84-33-889	3/8 x .035	62.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
49	S84-33-930-6	1L & 1R	Pressure and Return Line from Sta. 31.75 to Sta. 80.38	3/8 x .035	57.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
50	S84-33-930-3	1L & 1R	Pressure and Return Line from Sta. 31.75 to Sta. 80.38	3/8 x .035	55.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
51	S84-33-930-12	1L & 1R	Pressure and Return Line from Sta. 80.38 to Sta. 102.00	3/8 x .035	17.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
52	S84-33-930-9	1L & 1R	Pressure and Return Line from Sta. 80.38 to Sta. 102.00	3/8 x .035	26.00	Alum. Al. 52SO WW-T-787	AN818-6D *A* AN819-D AN819-D *
60	S84-33-939-17	1	Pressure and Return Line from Center Panel Support to Bulkhead Connector (Rear of Bomb Bay	3/8 x .035	22.00	Alum. Al. 52SO WW-T-787	AN818-6D *** AN819-6 AN819-6 *

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Stock</u>		<u>Size</u>	<u>Lgth.</u>	<u>Material</u>	<u>End Fittings</u>	
61	S84-33-939-16	1	Pressure and Return Line from Center Panel Support to Bulkhead Connector (Rear of Bomb Bay)	3/8 x .035	22.00	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6	AN818-6D AN819-6	***	*
62	S84-33-939-32	1	Return Line from Tee to Cross	1/4 x .035	23.00	Alum.AL. 52SO WW-T-787	AN818-4D AN819-4	AN818-4D AN819-4	*B*	*
63	S84-33-939-19	1	Pressure and Return Line from Center Panel Support to Bulkhead Connector (Rear of Bomb Bay)	3/8 x .035	24.00	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6	AN818-6D AN819-6	***	*
64	S84-33-939-18	1	Pressure and Return Line from Center Panel Support to Bulkhead Connector (Rear of Bomb Bay)	3/8 x .035	23.00	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6	AN818-6D AN819-6	***	*
65	S84-33-939-26	1	Pressure and Return Line from Rear of Center Panel to Support	3/8 x .035	34.00	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6	AN818-6D AN819-6	***	*
66	S84-33-939-3	1	Pressure and Return Line from Support to Forward Port of Tail Wheel Strut	3/8 x .035	89.00	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6	AN818-6D AN819-6	***	*
67	S84-33-939-31	1	Return Line from Lower "Vickers" Motor Drain	1/4 x .035	12.00	Alum.AL. 52SO WW-T-787	AN818-4D AN819-4	AN818-4D AN819-4	*B*	*
68	S84-33-939-30	1	Return Line from Upper "Vickers" Motor Drain	1/4 x .035	6.00	Alum.AL. 52SO WW-T-787	AN818-4D AN819-4	AN818-4D AN819-4	*B*	*

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
69	S84-33-939-25	1	Pressure Return Line from Rear of Center Panel to Support	3/8 x .035	34.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
70	S84-33-939-2	1	Pressure and Return Line from Support to Rear Port on Tail Wheel Strut	3/8 x .035	106.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
71	S84-33-939-63	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	6.63	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
72	S84-33-939-69	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	11.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
73	S84-33-939-66	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	6.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
74	S84-33-939-58	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	21.63	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
75	S84-33-939-53	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	22.25	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
76	S84-33-939-52	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	19.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
77	S84-33-939-51	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	23.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
78	S84-33-939-50	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	23.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
79	S84-33-939-54	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	7.38	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
80	S84-33-939-55	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	3.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
81	S84-33-939-56	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	3.88	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
82	S84-33-939-57	1	Pressure and Return Line from Bendix Check Valve to Tee	3/8 x .035	2.63	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
83	S84-33-939-67	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	7.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
84	S84-33-939-65	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	7.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *
85	S84-33-939-59	1	Pressure and Return Line from Vickers Motor to Tee	3/8 x .035	6.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D *** AN819-6 AN819-6 *

LINE ASSEMBLIES - LANDING GEAR AND FLAPS HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
86	S84-33-939-60	1	Pressure and Return Line from Vickers Motor to Tee	3/8 x .035	5.75	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
87	S84-33-939-68	1	Pressure and Return Line from Vickers Motor to Tee	3/8 x .035	10.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
88	S84-33-939-64	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	8.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
89	S84-33-939-62	1	Pressure and Return Line from Tee to Flap Control Valve	3/8 x .035	8.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
90	S84-33-939-61	1	Pressure and Return Line from Vickers Motor to Tee	3/8 x .035	3.13	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6 *** *
*	Substitute AC811T-CS type sleeve for AN819 - sleeve. Effective on airplane No. 41-18774 through No. 41-18798 only.						
**	Substitute 5/8 x .042 Alum.AL. 52SO tubing for 5/8 x .049 Alum.AL. 52SO tubing effective on airplane No. 41-18774 through No. 41-18778 only.						
***	Substitute 3/8 x .032 Alum.AL. 52SO tubing for 3/8 x .035 Alum.AL. 52SO tubing effective on airplane No. 41-18774 through No. 41-18778 only.						
*A	Substitute 3/8 x .032 Alum.AL. 52SO tubing for 3/8 x .035 Alum.AL. 52SO tubing effective on airplane No. 41-18779 through No. 41-18783.						
*B	Substitute 1/4 x .042 Alum.AL. 52SO tubing for 1/4 x .035 Alum.AL. 52SO tubing effective on airplane No. 41-18774 through No. 41-18778.						

their proper "OPEN" or "CLOSED" positions. The motors and control valves are incorporated with a gear box assembly which is installed in the trailing edge of the center panel on the airplane center line. The entire assembly is shown on fig. 15-IX. Two torque tubes extend outboard from each side of the gear box to operate screw-type jacks through bevel gears. These jacks are located at appropriate points along the aft face of the rear wing beam and operate the flaps. Note that the upper torque tube and jacks operate the lower flaps, and vice versa. The motor control valves are mounted at the forward end of the main gear box assembly and are themselves controlled by moving blocks which ride on two threaded shafts. These shafts are driven from the respective flap operating gears of the main gear box. A cam arrangement is also incorporated in the valve control mechanism for limiting the extension of the lower flaps to 25 degrees when they are used with the upper flaps in diving.

(2) Operation.- The mechanical features of this flap system are discussed in section IV. Only the hydraulic action and the directly related mechanical action will be discussed here. Refer to fig. 14-IX for location and arrangement of the hydraulic units. Refer to the schematic fig. 8-IX to trace the fluid flow as described herein. Refer to fig. 15-IX for details of the motor control valve arrangement.

(a) Landing Flaps.- Referring to fig. 8-IX, note that the landing flap selector valve detail, shown separate from the system, is positioned to extend the landing flaps. With the plunger in the position shown, fluid under pressure from the main hydraulic system is directed through lines to port "B" of the landing flap motor control valve. The ends of the control valve plunger are .050 inch smaller in diameter than the center portion, and the fluid pressure acting through the aft bleed passage operates against the effective difference in piston area to move the plunger to the full forward position, as shown. Fluid under pressure then flows to the landing flap motor, causes it to rotate, and returns through port "A" of the control valve, also through bypass containing check valve, and thence through the selector valve to the main system return line. As the motor rotates and operates the flap gear mechanism, the landing flaps open. At the same time, a block riding on a threaded shaft, which extends forward from the gear box, is moved aft by rotation of the shaft (see fig. 15-IX). As the flaps near their full "OPEN" position, the block engages an adjustable stop attached to the aft end of the valve plunger and carries the plunger aft with it, overcoming the fluid pressure which is tending to hold the valve open by holding the plunger forward. As the flaps reach their full "OPEN" position, the block forces the plunger far enough aft to cut off the fluid-flow to and from the motor, and the motor stops. The fluid is thus locked in the lines to and from the motor and the landing flap mechanism will remain in the "DOWN" position as long as the selector valve is left in the "DOWN" (or "NEUTRAL") position. The full "DOWN" position of the landing flap is 55 degrees from "NEUTRAL."

Referring again to fig. 8-IX, note that the landing flap detail shown connected into the system is positioned to close the landing flaps. With the plunger in the position shown, fluid under pressure from the main hydraulic system is directed through lines to port "A" of the landing flap control valve. The fluid flows through the forward bleed passage and acts against the plunger to move it to the full aft position, as shown. Fluid under pressure then flows to the landing flap motor, causes it to rotate to close the flaps, and returns through port "B," also through bypass containing check valve, of the control valve. At the same time, the block on the threaded shaft moves forward, engages an adjustable stop attached to the forward end of the valve plunger, and forces the plunger forward to cut off the fluid-flow to and from the motor, when the landing flaps reach the fully "CLOSED" position. Since the fluid is thus locked in the lines to and from the motor, the landing flap mechanism will remain in the "CLOSED" position as long as the selector valve is left in the "CLOSED" (or "NEUTRAL") position.

The foregoing discussion assumes that the selector valve control for the landing flap is placed and left in either the "DOWN" or "CLOSED" position, until the flap motor control valve stops the operation of the motor and mechanism, when the full "DOWN" or "CLOSED" position has been attained. If, however, the selector valve is placed in "NEUTRAL" while the motor is operating, the fluid in the lines between the selector valve and the motor will be locked, the motor will stop, and the flaps will remain fixed in the intermediate position they have attained. Subsequent movement of the selector valve will cause the flaps to move toward either the "DOWN" or "CLOSED" position in the normal manner.

(b) Diving Flaps.- Refer to fig. 15-IX and note that the upper flaps operate in exactly the same manner as the lower flaps. However, the control handle on the selector valve is so arranged that movement to operate the upper flap valve also operates the lower flap valve. The

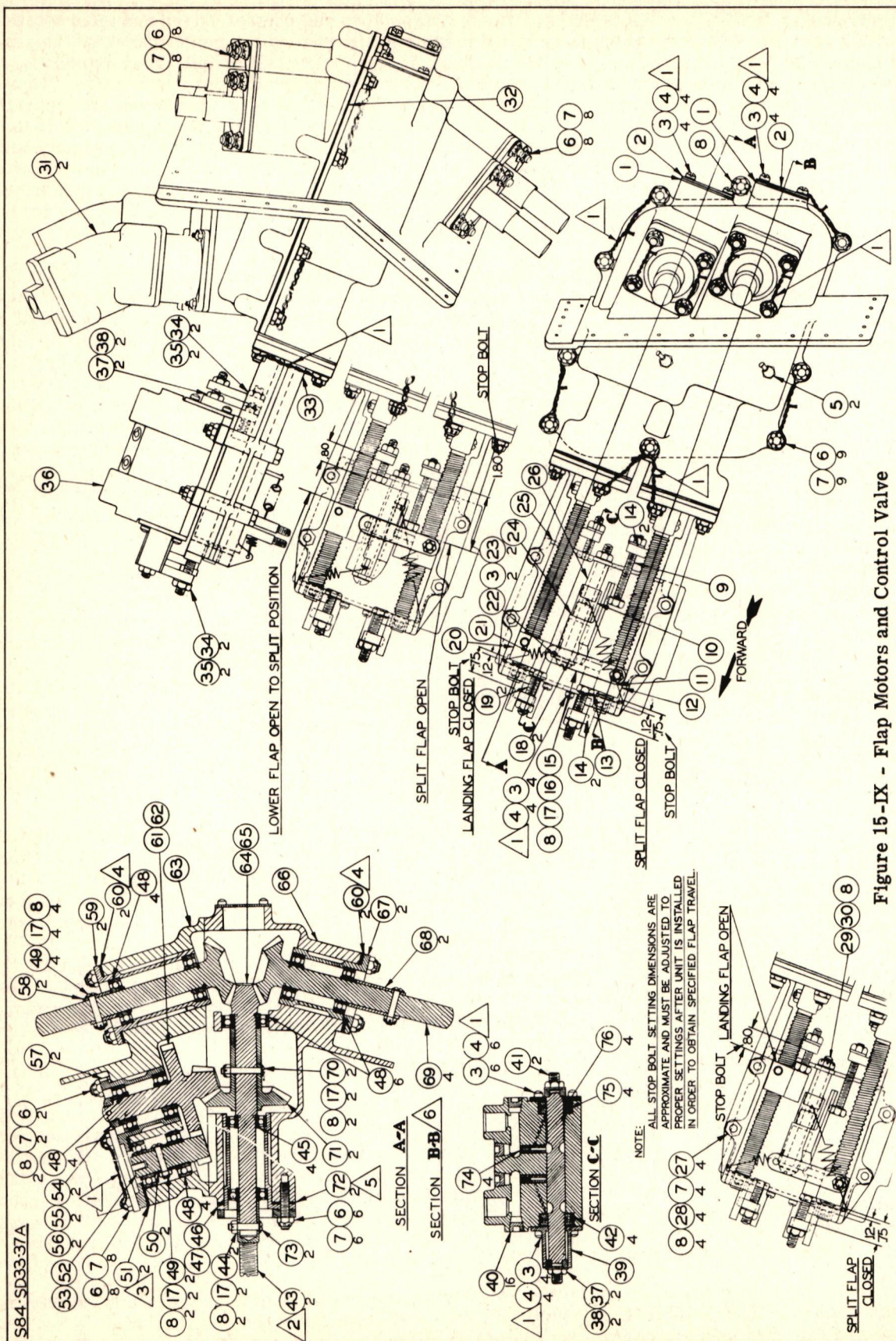


Figure 15-IX - Flap Motors and Control Valve

PARTS LIST - FLAP MOTORS AND CONTROL VALVE

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	2	Gasket	S84-33-757
2	2	Cover Rear	S84-33-756
3	24	Screw	AN502-10-6
4	22	Washer	AN960-D10
5	2	Lubricator	1637 Alemite or Equivalent
6	41	Washer	AN960-D416
7	45	Nut	AN310-4
8	18	Cotter Pin	AN380-C2-2
9	1	Bolt	1068-D-SAU-17
10	1	Stop Assembly	S84-33-777
11	1	Spring (Lower)	S84-33-744
12	1	Slide Assembly	S84-33-802
13	1	Bolt	1068-D-SAU-73
14	4	Arm	S84-33-780
15	1	Arm	S84-33-779
16	1	Washer	AN960-10L
17	11	Nut	AN320-3
18	2	Washer	AN960-416L
19	2	Bolt	1068-D-SAU-11
20	1	Slide (Upper)	S84-33-783
21	1	Spring (Upper)	S84-33-536
22	1	Bracket	S84-33-804
23	2	Washer	AN960-10
24	1	Cam	S84-33-805
25	1	Plate	S84-33-803
26	1	Spacer	S84-33-942
27	4	Bolt	AN4-23
28	4	Washer	AN960-416
29	1	Bolt	AN24-58
30	1	Nut	AN320-4
31	2	Flap Motor	Vickers No. MF9-713- 30-BCF
32	1	Gasket	S84-33-749
33	1L & 1R	Support Assembly	S84-33-785
34	4	Nut	AN315-4
35	4	Lock Washer	AN960-B416
36	1	Body	S84-33-787
37	4	Nut	AN315-5
38	4	Lock Washer	AN936-B516
39	1L & 1R	Retainer	S84-33-782
40	16	Plug	895-100
41	2	Plunger	S84-33-786
42	4	Retainer	S84-313-1011
43	2	Screw	S84-33-784
44	2	Bolt	S84-33-995
45	4	Bearing	K8A (Fafnir)
46	1	Spacer	S84-33-754
47	1	Spacer	S84-33-755 *
48	18	Bearing	K10A (Fafnir)
49	6	Bolt	AN23-16
50	2	Spacer	S84-33-765
51	2	Shim	S84-33-767
52	1	Pinion Spur	S84-33-758-1
53	1	Pinion Spur	S84-33-758-2 *
54	2	Nut	AN320-8
55	2	Washer	AN960-D816
56	2	Cotter Pin	AN380-C3-3
57	2	Spacer	S84-33-752

PARTS LIST - FLAP MOTORS AND CONTROL VALVE

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
58	2	Spacer	S84-33-764-1
59	2	Spacer	S84-33-747
60	4	Shim	S84-33-768
61	1	Gear-Bevel Spur	S84-33-760-1
62	1	Gear-Bevel Spur	S84-33-760-2 *
63	1	Box (Right-Half)	S84-33-750
64	1	Pinion (Main)	S84-33-762-1
65	1	Pinion (Main)	S84-33-762-2 *
66	1	Box (Left-Half)	S84-33-751
67	2	Spacer	S84-33-753
68	2	Spacer	S84-33-764-2
69	4	Gear Torque Shaft	S84-33-759
70	2	Bolt	AN23-20
71	2	Gear (Level)	S84-33-761
72	2	Shim	S84-33-769
73	2	Washer	AN960-C10
74	4	Restrictor	S84-33-997
75	4	Packing	AN6227-15
76	4	Packing	AN6227-9

① Lock wire required as shown.

② S84-33-784 to be flush against Fafnir bearings.

③ .062 nominal shim.

④ .032 nominal shim.

⑤ .075 nominal shim.

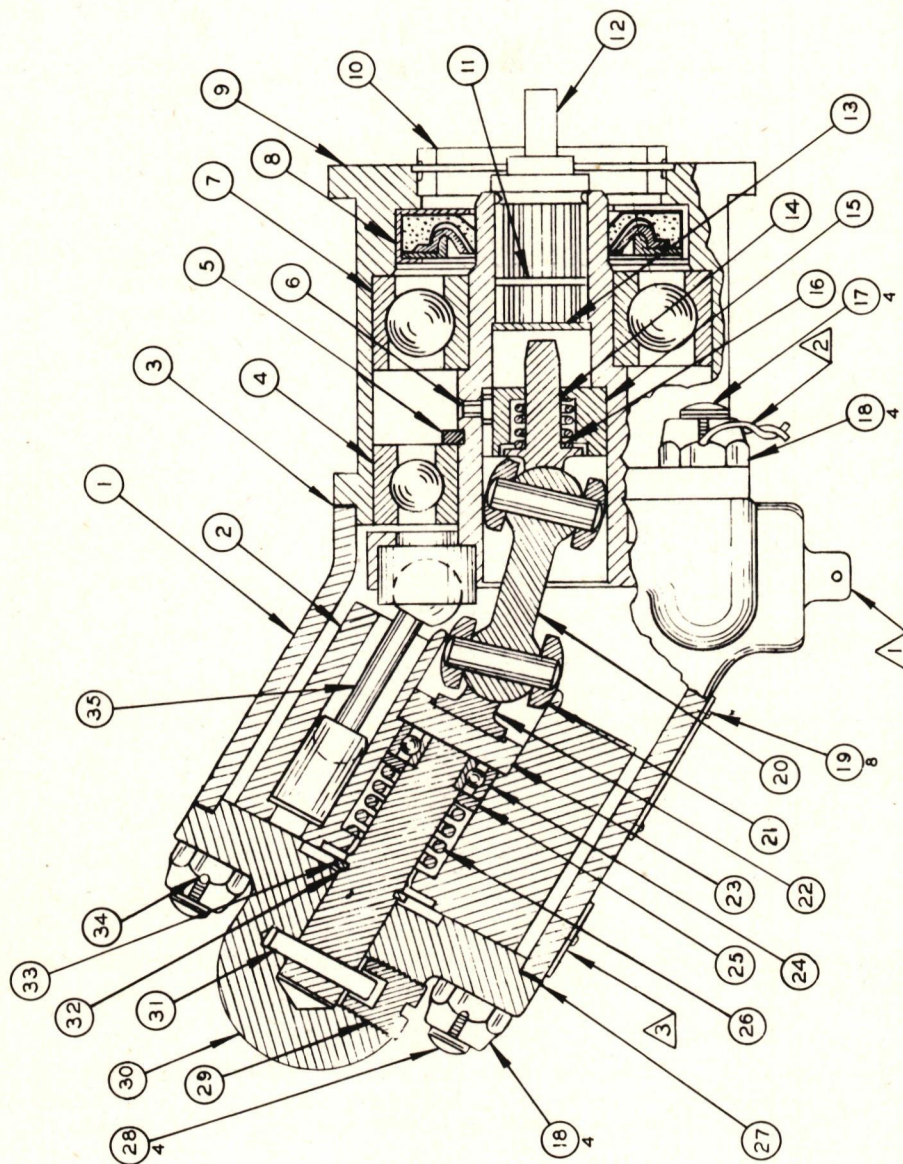
⑥ * All parts on section BB (lower motor) identical to those on section AA (upper motor) except those noted by * which are located on section BB (lower motor) only.

result is that the lower flaps begin to open in unison with the upper flaps. The control valve for the upper flap motor, however, limits the operation of the mechanism to 25 degrees extension of the flaps. Also, as the movable block on the threaded shaft of the valve control mechanism for the upper flaps leaves the fully "CLOSED" position, it engages a cam which, in turn, causes a spacer block to be introduced between the corresponding movable block and the stop, attached to the plunger of the control valve for the lower flaps. Consequently, the "DOWN" travel of the lower flaps is modified to equal the "UP" travel of the upper flaps or 25 degrees. This limitation of the range of the lower flaps is maintained so long as the upper flaps are partly or fully extended. Complete closure of the upper flaps restores the effective range of travel of the lower flaps to 55 degrees by removing the spacer block from the line of travel of the lower flap motor control mechanism.

1. Emergency Operation.- Emergency operation of the landing and diving flaps is essentially the same as normal operation except that hydraulic pressure is obtained by operation of the hydraulic hand pump.

2. The hydraulic hand pump, not accumulator pressure, should be used for checking the operation of the flap system after any service or maintenance operations involving adjustments of the flap hydraulic or mechanical units.

S84-SD33-26



(This Drawing Conforms to Vickers Inc. No. MF9-713-30-BCF)

Figure 16-IX - Hydraulic Motor

PARTS LIST - HYDRAULIC MOTOR

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Cylinder Housing	61691
2	1	Cylinder Block	46260
3	1	Gasket	46707
4	1	Bearing	43626
5	1	Snap Ring	43603
6	1	Key	42864
7	1	Bearing	38571
8	1	Oil Seal	48637
9	1	Mounting Flange	48079
10	1	Pilot Ring	42974
11	1	Snap Ring	52989
12	1	Tongued Shaft	44537
13	1	Plug Expansion	41814
14	1	Bearing Universal Link	43600
15	1	Retainer	46702
16	1	Spring	49431
17	4	Stud	3X-46699
18	8	Nut	3X-34567
19	8	Screw	44689
20	1	Subassembly	43585
21	1	Knuckle	43599
22	1	Bearing	43601
23	1	Retainer	46261
24	1	Bearing	42915
25	1	Retainer	46264
26	1	Spring	46750
27	1	Gasket	46701
28	4	Stud	3X-46698
29	1	Plug	3X-41369
30	1	Connection Cover	61064
31	1	Pin	2464
32	1	Cylinder Bearing Pin	46730
33	1	C - Washer	52951
34	1	Wire	48982
35	7	Subassembly	53412

NOTES:

- ① Drain: Must be open directly to reservoir.
- ② Wire: 48982.
- ③ Rotation Plate: Direction of rotation in relation to inlet and outlet connections is indicated.

3. Flap Selector Valve.- Figure 10-IX is a detail drawing of the combination landing gear and flap selector valve. Information given on the landing gear portion of the selector valve under "Landing Gear Hydraulic System" applies also to the flap portions of the valve.

4. Flap Motor.- The two flap motors are Vickers Model MF9-713-30-BCF. Figure 16-IX is a detailed assembly drawing of the motor.

a. Removal and Installation.- Before removing a flap motor, place the flap selector valve control in "NEUTRAL." It is also recommended that the accumulator hydraulic pressure be reduced to zero by operating other hydraulic equipment (except landing gear).

Disconnect the two fluid lines and the drain line from motor. Plug lines if fluid tends to drain.

Remove four cotter pins, nuts, and washers to remove motor from gear box assembly. To install, reverse removal procedure. Avoid getting dirt or grit in motor or lines. Use ample approved thread lubricant for fittings.

Following installation, operate motor several times to open and close flaps, to bleed air out of the system. Check for leaks.

b. Disassembly, Minor Repair, and Assembly.-

(1) The hydraulic motors used to operate the flaps and the gun turret are identical.

(2) To disassemble motor, proceed as follows, referring to fig. 16-IX.

(a) Remove the plug (29) in the connection cover (30) with a screwdriver. Pull out the pin (31) under the plug with a long-nose pliers. Remove the four nuts (18) that secure the connection cover. Lift off the connection cover. It is recommended that the hydraulic motor be held in vertical position with the connection cover up when doing this. As the connection cover comes away from the cylinder housing (1), make certain that the cylinder block (2) is not stuck to the connection cover and coming away with it. It may be necessary to hold the cylinder block with a small pointed tool inserted under the connection cover. Be careful not to scratch the valving surface of the cylinder block.

(b) Remove the nuts (18) holding the cylinder housing (1) to the mounting flange (9). The mounting flange encloses the shaft bearings and oil seal. Remove the cylinder housing while holding the cylinder block (2) in place so that pistons will not be pulled out of the cylinders.

(c) Remove the cylinder block (2), at the same time being careful not to drop out and lose retainer (25), bearing (22), and the four knuckles (21), all of which are held in place by the spring (16) pushing against universal link bearing (14).

(d) The four knuckles (21) must be kept in place on the universal link subassembly (20) so that when the unit is reassembled they will be returned to the same location. The universal link bearing (14) and spring (16) will come away free, also the bearing (22).

(e) The ball bearing (24) is swaged onto the cylinder bearing pin (32) and then slipped into the cylinder block (2), where it is held in place by a C-washer (33). This subassembly along with the retainer (23) may be pushed out after removing the C-washer if it is necessary to inspect the ball bearing, or the spring (26) which holds the cylinder block against the valve plate on the connection cover (30).

(f) The drive shaft, pistons, piston connecting rods, and connecting rod bearings constitute a subassembly (35). If found damaged in any way, this subassembly must be completely replaced, and it is recommended that the unit be returned to Vickers, Inc., Detroit, Michigan, U.S.A., for a complete overhaul and performance test. This subassembly is pressed into the ball bearing (4) and is held in place by a snap ring (5). The bearing and subassembly may be pressed out of the mounting flange (9) by applying slight force at the drive spline end of the shaft. Do not drive against the expansion plug (13). The thrust bearing (7) is pressed on to the drive shaft and slipped into the mounting flange and will come away with the subassembly. The oil seal (8) is pressed into the mounting flange and may be removed by applying pressure with a suitable tool in the same direction as when removing the bearing (4).

(g) The drain connection in the cylinder housing (1) must always be connected to the reservoir return line to provide a means of escape for any oil leakage that might occur in the motor.

(h) Evidence of hydraulic oil leakage at the mounting flange will indicate that the oil seal (8) is damaged or that the expansion plug (13) is leaking. This can be checked by connecting an outside pressure supply source to the cylinder housing (1), applying approximately 15 pounds per square inch pressure, and observing for leakage around the shaft or inside the spline. Damaged parts must be replaced.

(i) Replace worn or damaged parts when reassembling motor, reversing the procedure given for disassembly. Observe the following directions as they apply before and during reassembly.

(j) Make certain that universal link subassembly (20) and the four knuckles (21) are returned to the same position they were in when originally assembled. Most important of all, be absolutely certain that all parts are thoroughly clean and that they are covered with clean hydraulic fluid, Specification No. AN-VV-O-366a. It is recommended that parts be washed in clean kerosene, gasoline, trichlor ethylene, carbon tetrachloride, or other suitable or available mineral oil solvent when taken apart. Be certain that all small drilled oil holes and passages (in knuckles, knuckle pins, pistons at relief groove in skirt, etc.) are clean and free from sludge or foreign matter. Be certain that connecting rod balls turn freely in drive shaft bearing sockets and in piston sockets, and also that there is not excessive end-play in either socket. End-play should not exceed .002 inch to .003 inch in either socket.

(k) Reassembly of loose universal link drive parts can be greatly facilitated if a small amount of vaseline or high grade grease is used to keep them in place. This applies particularly to knuckles (21), bearings (14 and 22), and universal link subassembly (20).

(l) During reassembly of pistons into cylinder block, note that, due to an odd number of pistons, it is necessary that pistons be inserted into the correct cylinders so that universal link knuckles will enter the driving slots in cylinder block.

(m) When the pin (31) is being inserted into the cylinder bearing pin (32), it is necessary to pry the pin toward the connection cover of motor while driving the pin (31) into place.

(c) DIAGNOSIS OF IMPROPER OPERATION.-

The following chart lists the difficulties which possibly may be experienced with the motor and hydraulic system, and indicates the cause and remedy for each of the troubles listed. It should always be remembered that torque is proportional to pressure and that speed is proportional to the rate of oil delivery to the motor, also, that horsepower developed is dependent upon both pressure and speed. Adequate pressure gage equipment and a thorough understanding of the operation of the complete hydraulic system is essential to diagnose improper operation.

1. Trouble Shooting.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
a. Motor not turning over or not developing sufficient speed or power.	(1) System overload relief valve not set at current pressure (1350 pounds per square inch).	(a) Check system pressure and reset relief valve.
	(2) Driven mechanism binding because of misalignment or other damage.	(b) Remove motor and check torque requirement of drive shaft.
	(3) Scored valving surface on connection cover (30) or scored cylinder block (2) due to foreign matter in oil system.	(c) Replace damaged parts.
	(4) Pump or other components in system not functioning as intended.	(d) Check system throughout, particularly pump pressure and delivery.
	(5) Incorrect motor model for particular circuit.	(e) Check model number. Replace with correct size motor.
b. Motor turning in wrong direction.	(1) Incorrect piping between control valve and motor.	(a) Check circuit and determine correct piping.
c. External oil leakage from motor.	(1) Oil seal (8) worn or expansion plug (13) damaged.	(a) Check shaft drive coupling alignment and replace oil seal or expansion plug.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
	(2) Gaskets leaking due to reservoir drain not being properly connected.	(b) Drain line must be piped directly to oil reservoir.
Motor idling or drifting when control is in "OFF" position.	(1) Selector valve not closing in the "OFF" position.	(a) Check selector valve for port leakage.
	(2) Bypass check valves at motor control valve leaking.	(b) Repair or replace.

It is extremely important that hydraulic system oil be absolutely clean and free from foreign matter. If motor shows evidence of abrasive matter, complete system should be drained and refilled with clean oil.

5. Motor Control Valve.- The flap motor control valve comprises two identical plungers in a common body. A detail section of the valve is shown on fig. 15-IX.

a. Removal and Installation.- Before removing the flap motor control valve, place the flap selector valve in "NEUTRAL." It is also recommended that the accumulator hydraulic pressure be reduced to zero by operating other hydraulic equipment (except landing gear).

Disconnect the eight fluid lines from the valve. Plug any lines that tend to drain. Disconnect two springs from the cam mechanism attached to the valve body.

Remove four cotter pins, nuts, and washers to remove the valve assembly from the support assembly.

To install, reverse removal procedure. Avoid getting dirt or grit into valve or lines. Use ample approved thread lubricant on fittings.

Following installation, valve must be checked and adjusted as shown on fig. 15-IX.

b. Disassembly, Minor Repairs, and Assembly.- Disassembly procedure should be obvious from fig. 15-IX. However, the following procedure is recommended to replace packing.

Remove four nuts and washers that attach the four stop arms to the plunger ends. As the arms are removed, tag them so that they may be re-installed in their original location. Do not loosen or change adjustment of any of the stops on the arms. Remove lock wire and take out 14 fillister-head screws and washers to remove the valve end plates. Packing cups should be easily dislodged by withdrawing the plungers. Before removing plungers from the body, tag them so that they can be reassembled in their original positions. Handle plunger with extreme care.

Before installing new seals, clean parts thoroughly and allow to dry. Lubricate all seals thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing.

The following chart lists the difficulties which possibly may be experienced with the flap motor control valve and the check valves which are located between the flap motor control valve and hydraulic motor.

IMPORTANT: The flap selector valve will always be placed in "NEUTRAL" immediately after flap operation is completed. Some mechanics and most pilots use the "NEUTRAL" position for fractional flap operation only (usually at take-off). This is wrong practice and will result in "creeping" flaps with resultant damage to control mechanism and flaps.

All flap operation will be performed from the "CLOSED" position. In other words, if the landing flaps are "DOWN," it will be necessary to bring them to the "CLOSED" position before operating "SPLIT" flaps. If this procedure is not followed, damage to the mechanism will result.

TROUBLE SHOOTING FLAP MOTOR CONTROL VALVE

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
1. Flap selector valve set for operation. No action at flap motor.	a. Flap motor control valve stuck.	(1) Dirt in control valve. Clean thoroughly.
2. Leak at valve plungers.	a. Scored plungers or bad cup seals.	(1) Valve body worn causing plunger to bind. Change body. (2) Bleeder holes in valve body plugged with dirt. Clean thoroughly. (3) Remove and re-work shaft. If too pitted or scored, replace. (4) Install new cup seals.

6. Brake.-

a. Description.- A Goodyear disc-type hydraulic brake assembly is installed in each wheel of the main landing gear. Brake 12.7 x .125/.100 x 7 HP, assembly No. 510944M, as shown on fig. 17-IX, is installed in the 34 x 9 wheel. Brake 12.7 x .125/.100 x 7 HP, assembly No. 511415M, as shown on fig. 19-IX, is installed in the 34 x 9.9 wheel. Pressure for operating the brakes is obtained from the main hydraulic system through individual brake metering valves which are, in turn, controlled by rudder toe pedals.

Goodyear hydraulic brakes consist of multiple disc metal-to-metal clutches. The brake contains six bronze discs keyed to rotate with the wheel and alternating with seven steel discs which are non-rotating, being keyed to the brake anchor bracket.

To apply the brake, these discs are pressed together by means of an annular piston which is actuated directly by hydraulic fluid supplied through the brake metering valve. The multiple disc arrangement has the effect of spreading the frictional braking surfaces over a large area in a comparatively small space. The smooth and positive action of this type of brake is largely due to this feature. The disc arrangement is also inherently free from any tendency to either freeze or release due to rotation of the wheel.

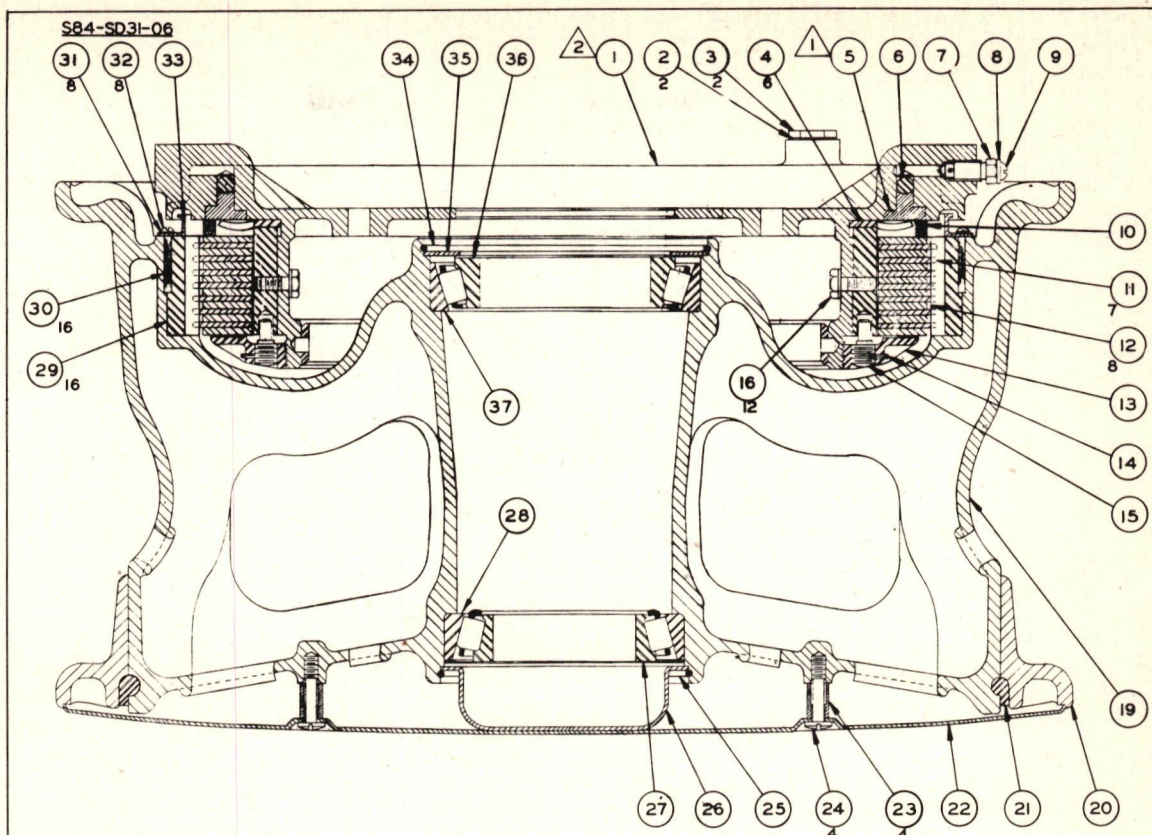
The brake anchor bracket previously mentioned is fastened by means of bolts to the torque plate on the landing gear of the airplane. Steel keys are bolted or riveted to the anchor bracket to which are keyed the non-rotating steel discs of the brake. The rotating discs have steel cores, on both sides of which friction material is deposited, to serve as a bearing surface against the non-rotating steel disc.

The discs are held in position on the anchor bracket by means of the steel anchor bracket nut. Proper clearance between the discs is obtained by adjusting the position of this nut, the nut being locked in position by means of a lock screw when the proper clearance is obtained.

An annular ring piston is provided for pressing the discs together to provide the desired braking effect. This piston is activated by the fluid of the brake system located in the brake cylinder. The brake cylinder is sealed by means of a synthetic rubber gasket held in position against the cylinder walls by a circular leaf-type spring.

b. Removal, Installation, and Adjustment.- To remove the brakes or adjust the disc clearance requires removal of the wheel, as previously described.

The brake may then be removed as a complete unit by removing the eight cotter pins, nuts, washers, and bolts that attach it to the anchor bracket, or it may be disassembled with the housing attached to the bracket.



Ref. No.	Quantity	Item	Part No.
1	1	Brake Subassembly	510945-M
2	2	Inlet Washer	AN902-5
3	2	Inlet Plug	218375
4	6	Piston Return Spring	218608
5	1	Piston Assembly	510512-M
6	1	Piston Seal	510511
7	1	Bleeder Plug	218613
8	1	Bleeder Washer	AN960-10
9	1	Bleeder Capscrew	AN520-10-6
10	1	Insulating Disc	218609
11	7	Rotating Disc	530031
12	8	Stationary Disc	530030
13	1	Disc Retaining Nut	731631
14	1	Cotter Pin	AN380-2-2
15	1	Nut Lock Screw	510534
16	12	Screw and Washer	Sems Unit H61-250871-53 *
19	1	Wheel Casting	530231-2M **
20	1	Demountable Flange	510792-M
21	1	Flange Lock Ring	510783-3
22	1	Fairing	510538
23	4	Sleeve	218053
24	4	Screw	218052
25	1	Hub Cap Lock Wire	510779-6
26	1	Hub Cap	510814
27	1	Outboard Bearing Cone	Timken 39250
28	1	Outboard Bearing Cup	Timken 39422 **
29	16	Drive Spline Insert	218340-10 **

Figure 17-IX - Wheel and Brake Assembly - Type I

PARTS LIST - WHEEL AND BRAKE ASSEMBLY - TYPE I

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
30	16	Drive Spline Insert Lock Pin	218341-5 **
31	8	Commercial Washer	Shakeproof No. 1210
32	8	Round-Head Screw	AN520-10-4
33	1	Labyrinth Seal Ring	218357-1
34	1	Inboard Bearing Closure Lock Wire	510779-1
35	1	Inboard Bearing Closure Ring	218349-5
36	1	Inboard Bearing Cone	Timken No. 34300
37	1	Inboard Bearing Cup	Timken No. 34479 **

NOTES:

- ① Piston assembly No. 510512-M consists of parts listed below. These parts are not furnished separately.

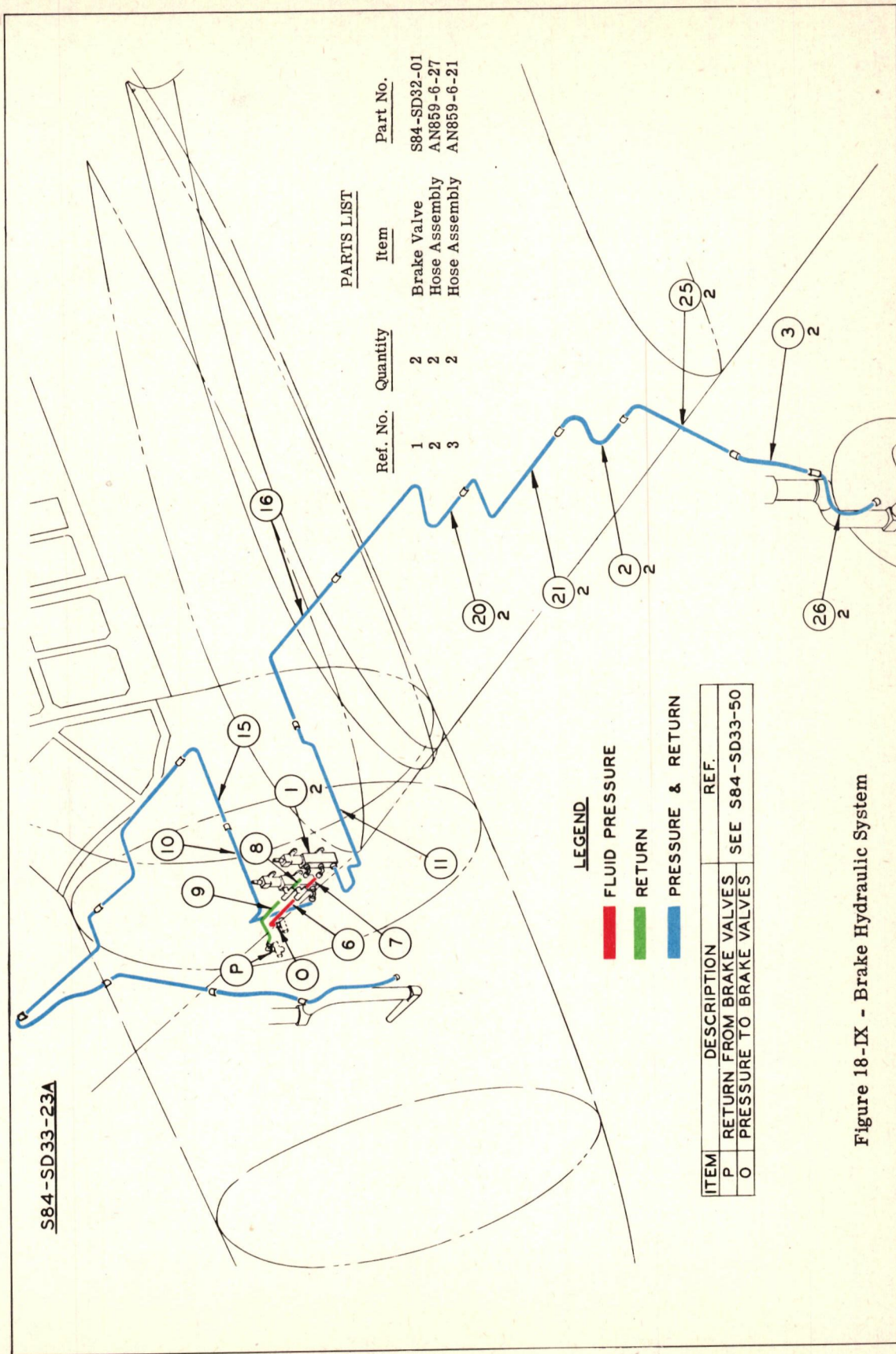
1	Piston	510512-1M
3	Piston Pin	218610-2
6	Spring Pad	218610-3

- ② Brake subassembly No. 510945-M consists of parts listed below. These parts are not furnished separately.

1	Anchor Bracket	530348-M
1	Bracket Reinforcing Ring	510044
12	Anchor Key	510019-5
2	Dowel	216928

3. Items No. 1 through 16 inclusive are Goodyear Tire and Rubber Co. brake assembly No. 510944-M.
4. Items No. 19 through 37 inclusive are Goodyear Tire and Rubber Co. wheel assembly No. 530244-M.
5. Items 3 and 4 are effective on Curtiss-Wright assembly S84-31-901 - units No. 1 through 849 only.

- * Alternate for replacement of H61-250871-53 is AN4-4A plus AN936-A21C.
- ** Items indicated make up Goodyear Tire and Rubber Co. wheel subassembly No. 530245-M.



PARTS LIST

Ref. No.	Quantity	Item	Part No.
1	2	Brake Valve	S84-SD32-01
2	2	Hose Assembly	AN859-6-27
3	2	Hose Assembly	AN859-6-21

LEGEND

- FLUID PRESSURE
- RETURN
- PRESSURE & RETURN

ITEM	DESCRIPTION	REF.
P	RETURN FROM BRAKE VALVES	SEE S84-SD33-50
O	PRESSURE TO BRAKE VALVES	

Figure 18-IX - Brake Hydraulic System

LINE ASSEMBLIES - BRAKE HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
6	S84-33-936-37	1	Pressure Line from Right-Hand Brake Valve to Tee	3/8 x .035	17	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
7	S84-33-936-31	1	Pressure Line from Left-Hand to Right- Hand Brake Valve	3/8 x .035	3	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
8	S84-33-936-30	1	Return Line Left- Hand to Right-Hand Brake Valve	3/8 x .035	3	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
9	S84-33-936-38	1	Return Line from Right-Hand Brake Valve to Cross	3/8 x .035	20	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
10	S84-33-936-39	1	Pressure and Return Line Right-Hand Brake Valve to Sta. 35.00	3/8 x .035	40	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
11	S84-33-936-25	1	Pressure and Return Line Left-Hand Brake Valve to Station 35.00	3/8 x .035	44	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
15	S84-33-938-10	1	Pressure and Return Line from Station 35.00 to Center Panel	3/8 x .035	27.88	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
16	S84-33-938-41	1	Pressure and Return Line from Station 35.00 to Center Panel	3/8 x .035	35.31	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

LINE ASSEMBLIES - BRAKE HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
20	S84-33-930-7	1L & 1R	Pressure and Return Line Station 59.50 to Station 80.38	3/8 x .035	58	Alum.Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
21	S84-33-930-13	1L & 1R	Pressure and Return Line Station 80.38 to Station 102.00	3/8 x .035	26	Alum.Al. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
25	S84-32-501-3	1L & 1R	Hose Assembly to & Hose Assembly	3/8 x .035	32	Alum.Al. 52SO WW-T-787	AN817-6D AN817-6D
26	S84-32-501-1	1L & 1R	Hose Assembly & to Brake	3/8 x .035	16	Alum.Al. 52SO WW-T-787	AN817-6D AN817-6D

Brake units are interchangeable - that is, any brake can be installed on either a right or left landing gear unit.

When installing a brake on the anchor bracket, be sure that the bleeder port is located at the top of the assembly in line with the wheel fork.

To disassemble the brake, proceed as follows:

Remove the lock screw from the annular disc retaining nut.

Unscrew and remove the annular disc retaining nut.

Remove the bronze and steel discs. It is recommended that the order and position of the discs with respect to each other be maintained.

Remove the insulating (last) disc.

Remove the piston return springs.

Remove the piston.

Remove the piston seal and expander spring.

To reassemble the brake, reverse the above procedure. Before installing the piston seal, see that the expander spring is installed in the seal with the lips up and with the wide notches toward the inside. Locate the ends of the spring in the seal first, making certain that they meet but do not overlap. All segments of the spring must be inside the lips of the seal.

To facilitate installation of the expander spring, and subsequent installation of the seal assembly, lubricate the seal with clean hydraulic fluid, Specification No. AN-VV-O-366a. Before installing the seal, make sure that the cylinder cavity is clean. Install the spring and seal assembly lips inward, being careful to feed the seal into the cavity progressively so that the lips will not be cut or the spring forced from inside the lips.

Make sure that the insulating disc is installed next to the piston. Install steel and bronze discs alternately so that steel discs are next to the insulator disc and the annular disc retaining nut.

Adjust the brake clearance by first tightening the annular disc retaining nut, then backing it off until a total clearance for all discs of .050 to .055 inch is obtained. Use at least two feeler gages to set the clearance, placing them 180 degrees apart. If three feeler gages are available, use them with 120 degrees spacing. Proper clearance adjustment cannot be made with one feeler gage. After proper clearance has been obtained, back off the annular disc retaining nut to the next locking position and install the lock screw.

c. General Maintenance. - Following any service operation where the brake fluid line is disconnected or the brake piston removed, the brake must be bled. For bleeding procedure, refer to paragraph 5, c, on the Hydraulic System.

Worn discs will be replaced. If discs are found to be dished or warped, remove and flatten them by tapping them on a flat plate until they return to a flat condition. If dished, tap on outer circumference, and if warped, tap on inner circumference.

If seals are found to be worn or shrunk, or in any way damaged, replace with new seals.

Broken or weak return springs will be replaced with new springs.

Clean the brake piston seal in aromatic naphtha, Specification No. AAF-14101 and clean brake cylinder and piston.

The threads on the anchor bracket casting should be given a coating of thread lubricant, Specification No. AN-C-53. No other lubrication of the brake unit is required.

The following list of possible service troubles and their remedies is provided as an aid in servicing and maintaining Goodyear disc-type brakes and to point out what certain conditions may indicate and how to make suitable corrections.

d. Excessive Pedal Travel or Insufficient Braking Action.-

(1) Probable Cause.-

Normal wear of bronze discs.

Improper adjustment of clearance between discs.

Leak in the system.

Air in the system.

Improper brake pedal setting or linkage.

(2) Remedy.- As the discs wear and become thinner, the brake piston must travel farther. This results in greater fluid displacement and consequently calls for adjustment of disc clearance.

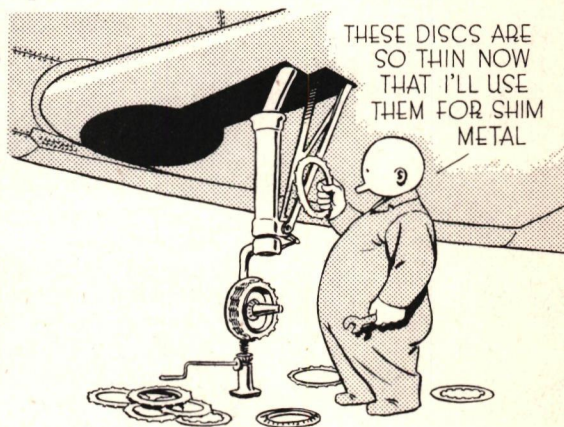
Remove wheel from brake unit. Remove retaining nut lock screw from brake unit. Turn retaining and adjustment nut up tight. Then turn back until specified clearance is available.

When discs are worn to such an extent that the adjusting nut cannot be tightened up to the specified clearance, a stationary steel disc should be inserted in the stack next to the adjusting nut and the brake then adjusted to the proper clearance. (See recommended procedure.)

When discs are so thin that further adjustment is impossible or condition calls for renewal, replace with new set of discs.

Check to see that clearance between discs is as specified. This can be measured with feeler gages. (See recommended procedure.)

If too much pressure is used when bleeding the system or the system is bled several times in short period of time, the fluid may become full of small air bubbles. Wait until air accumulates in large bubbles so it can be eliminated by bleeding.



e. Dragging Brakes.-

(1) Probable Cause.-

Improper adjustment of clearance between discs.

Dirt in system.

Binding of brake piston.

Use of improper fluid.

Weak or broken brake piston return springs.

Weak or broken master cylinder piston spring.

Dished or warped bronze or steel discs.

Mechanical pedal linkage frozen.

S84-SD31-07

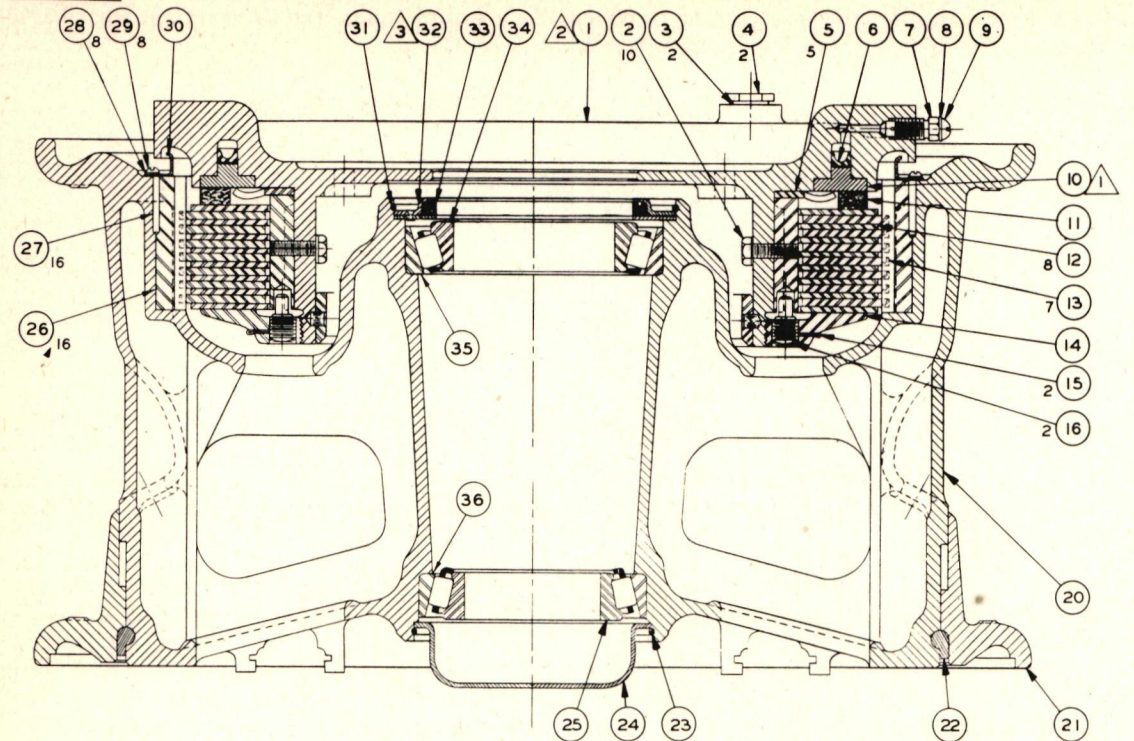


Figure 19-IX - Wheel and Brake Assembly - Type II

PARTS LIST - WHEEL AND BRAKE ASSEMBLY - TYPE II

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Brake Subassembly	511422-M
2	10	Screw and Washer	SEMS Unit H61-251271-51 *
3	2	Inlet Washer	AN902-5
4	2	Inlet Plug	218375
5	5	Brake Release Spring	218608
6	1	Piston Seal Gasket	511312-6
7	1	Bleeder Plug	218613
8	1	Bleeder Washer	AN960-10
9	1	Bleeder Screw	AN520-10-6
10	1	Piston Assembly	511297-M
11	1	Insulator Disc	530276
12	8	Stationary Disc	530268-2
13	7	Rotating Disc	530269-2
14	1	Disc Retaining Nut	530270
15	2	Cotter Pin	AN380-2-2
16	2	Retaining Nut Lock Screw	510534
20	1	Wheel Casting	530666-M **
21	1	Demountable Flange	530667-M
22	1	Flange Lock Ring	510783-10
23	1	Hub Cap Lock Wire	510779-6
24	1	Hub Cap	510814
25	1	Outboard Bearing Cone	Timken 39250
26	16	Drive Spline Insert	218340-20 **
27	16	Drive Spline Insert Lock Pin	218341-5 **
28	8	Commercial Washer	Shakeproof No. 1210
29	8	Round-Head Screw	AN520-10-6
30	1	Labyrinth Seal Ring	218357-1

PARTS LIST - WHEEL AND BRAKE ASSEMBLY - TYPE II

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
31	1	Inboard Felt Retainer Lock Wire	511389-2
32	1	Inboard Felt Retainer Ring Assembly	511407-3
33	1	Inboard Felt Bearing Seal Ring	510526-31
34	1	Inboard Bearing Cone	Timken No. 34300
35	1	Inboard Bearing Cup	Timken No. 34479 **
36	1	Outboard Bearing Cup	Timken No. 39422 **

- △ 1 Piston assembly No. 511297M consists of parts listed below. These parts are not furnished separately.

1	Piston	511296-M
5	Piston Pin	218610-2
10	Spring Pad	218610-3

- △ 2 Brake subassembly No. 511422M consists of parts listed below. These parts are not furnished separately.

1	Anchor Bracket	530664M
10	Anchor Key	510019-10
1	Reinforcing Ring	218361-5
2	Dowel	510757-1

- △ 3 Inboard felt retainer ring assembly No. 511407-3 consists of parts listed below. These parts are not furnished separately.

1	Bearing Closure Ring	218349-31
1	Felt Retainer Ring	511408-3
4	Rivet	AN425A3-4

4. Items No. 1 through 16 inclusive are Goodyear Tire and Rubber Co. brake assembly No. 511415M.

5. Items No. 20 through 36 inclusive are Goodyear Tire and Rubber Co. wheel assembly No. 530660M.

6. Items 4 and 5 are effective on Curtiss-Wright assembly S84-31-901 - units 850 and up.

- * Alternate for replacement of H61-251271-51 is AN4-6A plus AN936-A416.

- ** Items indicated make up Goodyear Tire and Rubber Co. wheel subassembly No. 530665M.

Dragging or locked brakes may be due to dirt in the system.

Dirt in the system may get under the rubber seals in the master cylinder or under the brake piston seal and cause leaks.

If dirt is found in the system, remove both metering valves and dismantle the brake assemblies. Then flush brake system lines thoroughly with kerosene. Federal Specification No. VV-K-211, or naphtha, Specification No. AN-VV-N-96. Brakes will require bleeding after flushing.

(2) Remedy.- If discs are adjusted to provide less clearance than recommended, excessive heat from dragging may result. See "Remedy" under "Excessive Pedal Travel" for proper adjustment.

Dismantle the metering valves and clean all parts. Then reassemble and install. (See fig. 20-IX.)

Clean brake piston seal and clean the brake cylinder and piston. Then reassemble.

Bleed system after all items are re-installed.

Dust and dirt mixing with brake fluid at the brake piston may become gummy and may cause sticking of the brake piston. Parts should be removed and thoroughly cleaned. Then re-install.

Improper fluid will not operate properly under severe heat or cold conditions. Such fluid may destroy brake piston seals. In such case, replace with new seals.

If brake piston return springs are broken or weak, the brake piston will not return to full "OFF" position, or will move more slowly than desired. Consequently, the returning fluid will move sluggishly and the usual feel of the brake will be lacking. This might also cause dragging or locked brakes. Replace with new springs.

Dished or warped discs seldom occur. However, if discs are discovered to be in this condition, remove them and place them on a flat plate and tap until they return to flat condition. Then re-install.

If impossible to correct, or if discs have become too badly worn from operating in this condition, they should be replaced with new discs. Dished or warped discs will change the clearance or adjustment and dragging brakes might result.

4. Brake Hydraulic System.

a. Description.- The landing wheel brake hydraulic system consists of two Goodyear multiple-disc type brake units, two Vickers brake valves, and the necessary lines and fittings. The valves are connected to conventional rudder toe pedals by means of two push-pull rods and a bell crank.

The Goodyear multiple-disc type brakes derive the desired pressure for their operation from the main hydraulic system through the Vickers valves. Independent operation of each brake is provided by incorporating a Vickers brake valve below each brake pedal.

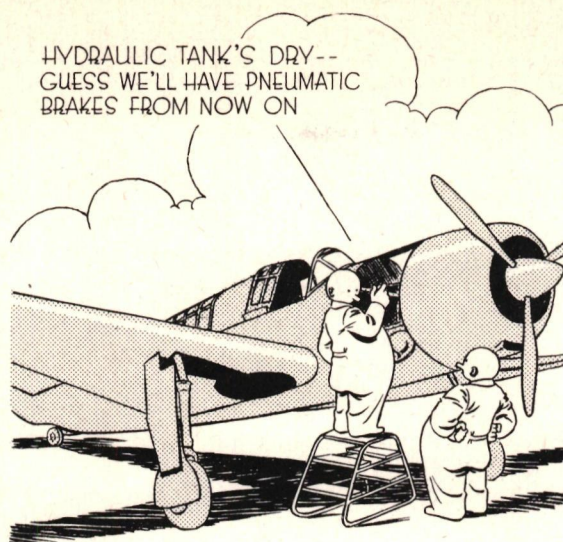
Refer to preceding paragraph 4 of this section for detailed information on the wheel brake units and mechanical features of the installation.

b. Operation.- The main hydraulic system which provides pressure for operating the brake hydraulic system is discussed in paragraph 4 of this section. However, the portion of the hydraulic system pertaining exclusively to the operation of the brakes is discussed below and shown in perspective on fig. 18-IX.

The Goodyear multiple-disc type brakes consist of multiple discs and metal-to-metal clutches, see fig. 17-IX. Seven bronze discs keyed to rotate with the wheel are alternated with eight steel discs which are non-rotating, since they are keyed to the brake anchor bracket.

To apply the brakes, these discs are pressed together by means of an annular ring piston, being actuated by hydraulic fluid from the main hydraulic system through Vickers brake valves when the brake pedals are depressed. The multiple-disc arrangement has the effect of spreading the frictional braking surfaces over a large area in a comparatively small space. The smooth and positive action of this type of brake is due largely to this feature; also the disc arrangement is inherently free from any tendency to either freeze or release, due to rotation of the wheel.

c. Bleeding of Brake System.- Remove capscrew from bleeder plug in the brake and insert in its place a standard bleeder hose. Place the free end of the hose in a clean glass receptacle. Back off the bleeder plug and depress the corresponding brake pedal carefully until fluid is being discharged at a fairly rapid rate. Do not depress the pedal too much and do not allow an



excessive amount of fluid to be discharged needlessly. When the fluid issues free of air bubbles, release the brake pedal, close the bleeder plug, remove the bleeder hose, and replace the bleeder plug capscrew.

CAUTION: Do not allow hydraulic reservoir to run dry or it will be necessary to refill the tank and re-bleed the system.

d. Brake Valve.

(1) Description and Operation.—Two identical brake valves, Vickers Model AA-13032, are connected hydraulically to the respective wheel brake units and are operated by mechanical linkage from the brake pedals.

Figure 20-IX is a detail of the brake valve. Normal hydraulic pressure from the main hydraulic system is applied at port "A" of each valve. Port "C" of each valve is connected to the hydraulic return line to the reservoir. The remaining port (port "B") of each valve is connected to the brake line of the respective wheel brake unit.

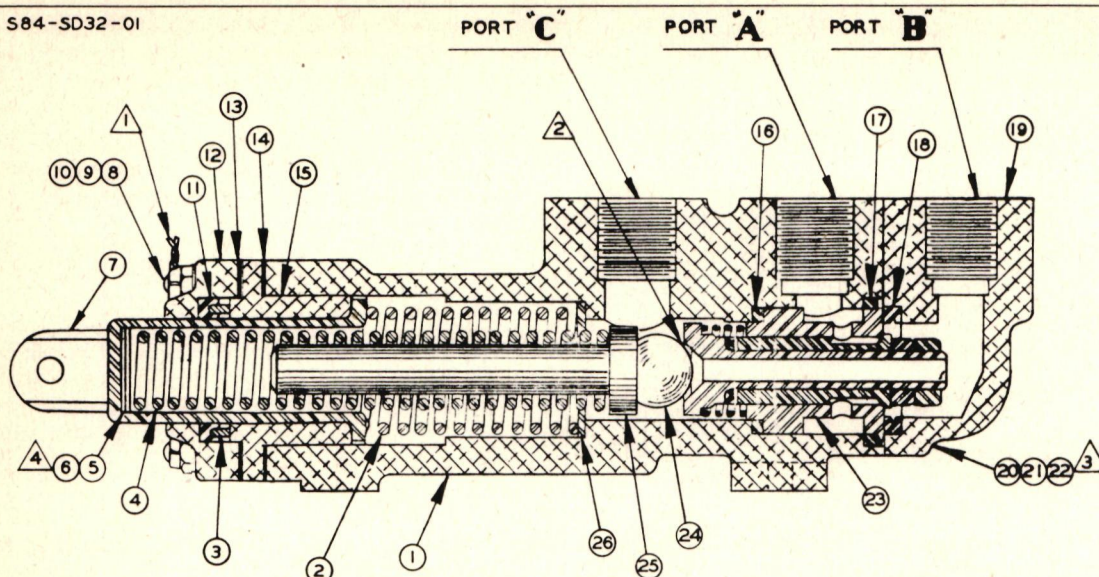
The function of the brake valve is to translate mechanical displacement of the plunger into a definite fluid pressure to the brake through port "B." This is accomplished by metering the fluid pressure available at port "A" in the following manner:

Supply pressure available through port "A" exerts equal pressures in both fore and aft directions against the movable portion of the valve (23). Therefore, a spring under comparatively low compression at the forward end of this movable portion is sufficient to prevent opening of the valve, due to supply pressure.

The spring (4) is installed so that the ball (24) is free of the seat of the valve (23) when the plunger (7) is fully released (extended). The brake line connected to port "B" is thus open through valve (23), when the plunger (7) is fully released.

However, when the plunger (7) is moved inward, the spring (4) moves the guide (25) inward, seats the ball (24) in the valve (23), and in turn opens the valve (23) by moving the center portion off its seat. Fluid under pressure at port "A" then flows through the aft portion of valve (23) into port "B" and to the brake line. As the fluid flows into the brake line and brake, pressure builds up in port "B" gradually moving the center of valve (23), against the compression of spring (4), back to its seat. The pressure in port "B" at which valve (23) closes is thus dependent upon the compression in spring (4), which in turn is dependent upon the displacement of plunger (7). When valve (23) closes as a result of the pressure built up in port "B," it will remain closed and retain that pressure as long as the position of the plunger (7) is not changed. If the plunger (7) is subsequently moved farther inward, the valve (23) again opens port "A" to port "B" to build up pressure in port "B" and the brake to some higher pressure which will again close the valve (23) in the manner previously described. The total operating movement of the plunger (7) is 7/8 inch, which will produce hydraulic braking pressure at port "B" of 0 pounds per square inch to 340 pounds per square inch. The manual force, required at the plunger to depress it 7/8 inch and hold under 340 pounds per square inch pressure at port "B," is 195 pounds.

When pressure against the plunger (7) is relieved, partially or wholly, the pressure existing in port "B" overcomes the spring pressure against the ball (24) and forces it from its seat in valve (23), thus allowing fluid to flow from port "B" through the valve (23) into port "C" and the return line. The ball (24) will re-seat in the valve (23) when the pressure at port "B" balances the pressure from spring (4), which in turn depends upon the position of the plunger (7). Thus it may be seen that the position of the plunger (7) determines the hydraulic braking pressure maintained at port "B."



Ref. No.	Quantity	Item	Part No.
1	1	Body	73353
2	1	Spring	63494
3	1	Spacer	62965
4	1	Spring	72847
5		Shim	50791 (.030)
6		Shim	59231 (.010)
7	1	Plunger	13X-60191
8	4	Washer	3X-49245
9	4	Nut	3X-40665
10	4	Stud	3X-51951
11	1	Ring	45342
12	1	Cover	60192
13	1	Gasket	60194
14	1	Gasket	60234
15	1	Sleeve	60193
16	1	Gasket	49384
17	1	Gasket	51428
18	1	Vickers Seal	50777
19	1	Cover	63028
20	2	Washer	3X-49072
21	2	Nut	3X-34567
22	2	Stud	3X-43449
23	1	Valve Subassembly	49382
24	1	Ball	1654
25	1	Guide	60230
26	1	Washer	53470

NOTES:

- ① Lock wire required as shown.
- ② Ball must clear seat by 1/32-inch minimum at assembled position.
- ③ These parts not shown.
- ④ Use shims as required to obtain clearance of 1/32-inch minimum between ball (24) and seat of valve subassembly (23).

Figure 20-IX - Single Brake Valve

(2) Diagnosis of Improper Operation.- The following chart lists the difficulties which may possibly be experienced with the brake control valve and hydraulic system and indicates the cause and remedy for each of the troubles listed. It should always be remembered that pressure is dependent primarily upon the ability of the hydraulic system pump to deliver the hydraulic fluid at the rate and pressure required by the circuit. Make certain that this condition exists before attempting to change adjustment of the brake control valve or check it for faulty operation. Adequate pressure gage equipment and a thorough understanding of the operation of the complete hydraulic system is essential to diagnose improper operation.

(3) Trouble Shooting Hydraulic Brake Valve.-

NOTE: Have an extra hydraulic gage for test purposes only. Have several short pieces of tubing with gage size fitting on one end. On the other end of each piece of tubing, install fittings to conform to various size fittings found on the several units. Some will have to be bushed to proper size.

- (a) Disconnect hydraulic line at port "C." (Close secondary system hydraulic valve.)
- (b) Install gage at port "C."
- (c) Jack airplane up until wheels clear the ground.
- (d) Using hand pump, build 1000 pounds pressure on system hydraulic gage. Brake "OFF."
- (e) Watch test gage at port "C" carefully. There must be no pressure at this gage. If any pressure is indicated on gage or if wheels start to drag while being rotated, the pressure valve (subassembly (23)) is leaking. Before removing for repair, perform the following test.
- (f) Depress brake pedal. There must be no pressure at test gage. If any pressure is indicated at gage, ball check valve (24) at port "C" is leaking. Must have 1/32-inch clearance with brake "OFF." Replace ball and lap seat with No. 500 compound.
- (g) Holding pressure on valve, check for leaks at (13), (14), and around stem.
- (h) Remove cap (19). Subassembly (23) and ball (24) can be removed from this end of valve. If valve leaks at (13), (14), or stem, valve will have to be removed from airplane and cap (12) and sleeve (15) removed to replace packing or broken springs.
- (i) Using No. 500 lapping compound, lap all valve surfaces or, if too badly pitted, replace.
- (j) As dirt is the most likely cause of hydraulic failure, be sure that valve is absolutely clean.

Reassemble, re-install, and test as shown above.

NOTE: It is extremely important that hydraulic system fluid be absolutely clean and free from foreign matter. If valve shows evidence of abrasive matter in the fluid, complete system should be drained, flushed, and refilled with fluid, Specification No. AN-VV-O-366a. Use kerosene or naphtha for flushing; see T. O. No. 06-1-2.

(4) Removal and Installation.- Before disconnecting the hydraulic lines from either valve, operate the flaps to reduce the hydraulic accumulator pressure to zero.

Other phases of removal and installation are of a mechanical nature and should be obvious. When installing or adjusting the valves and linkage, be sure that each valve plunger (item 7, fig. 20-IX) extends to the fully released position when the pedals are in the "OFF" position.

(5) Disassembly, Minor Repair, and Assembly.- The manner in which part or all of the brake valve can be disassembled may be understood by referring to fig. 20-IX.

The valve assembly (23) may be removed by first removing the cover (19). These operations will also permit removal and installation of seals (16), (17), and (18). The ball (24) may be removed after the valve (23).

The plunger (7), guide (25), and springs (2 and 4) may be removed by first removing the cover and sleeve (12 and 15).

Before installing new seals, clean parts thoroughly and allow to dry. Lubricate all seals and the valve assembly (23) thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing.

5. Guns Hydraulic System.

a. Description.- Both wing gun installations are charged hydraulically. The flexible turret gun is charged hydraulically on airplanes No. 41-18774 through 41-18783. The flexible turret gun is charged manually on all others. Each charging installation consists essentially of a Vickers gun charger No. 76862 mounted on the gun and a Vickers gun charger control valve No. 76861 mounted in the pilot's cockpit or turret as the case may be. When two guns are installed in each half of the center panel, the two chargers are controlled simultaneously by one control valve. Hydraulic pressure is obtained from the main hydraulic system.

b. Gun Charger Control Valve (Bendix No. 76861).- The Bendix hydraulic gun chargers and hydraulic gun charger control valves provide means for charging the guns without mechanical connections from the control valves to the chargers on the guns.

(1) The power used to charge the guns hydraulically is supplied by the main hydraulic system. The supply pressure must be above 800 pounds per square inch for the control valve and charger to operate properly. Therefore, the only additional parts required are two hydraulic gun charger control valves in the cockpit and one in the turret, a hydraulic charger at each of the guns, hydraulic lines connecting the control valves and the hydraulic system, the control valves and chargers, and the control valves and hydraulic reservoir.

With the control valve handle turned to the firing position, charging is accomplished by depressing the plunger through a stroke of 3/8 inch. The valve plunger will remain in this open position, in which fluid is free to flow to the charger cylinder until the gun bolt is fully retracted. When the bolt strikes the gun buffers, the valve plunger will automatically close, opening the passage from the charging cylinder to the return line and allowing the hydraulic charger cylinder piston to return as the fluid is discharged from the cylinder by action of the charger spring.

(2) A safety feature is incorporated in the charging system whereby it is impossible to fire the gun should the firing switch be inadvertently closed. To hold the gun safe, the control valve handle is turned counterclockwise 140 degrees and then depressed. The valve will automatically close in the manner previously described, but the hydraulic fluid will remain trapped in the line. Thus, the gun will be safe until the handle is rotated clockwise 140 degrees to the firing position, under which condition the fluid is exhausted from the cylinder and the bolt returns forward for firing.

(3) Fig. 22-IX is a detailed section of the control valve, which is a Bendix valve No. 76861 with an extension tube S84-33-554 added.

Before operating, the control valve handle (1) should be turned to the required position, either firing or safe, as the case may be. When the handle is in the firing position, the ball check (18) in the cylinder port will be unseated by displacement of pin (19) riding on eccentric portion of plunger (35). If the handle is in the safe position, the ball check (18) in the cylinder port will be seated, and, therefore, trap in the charger cylinder any fluid that may flow through the cylinder port.

(4) To charge the guns, the handle (1) should be pushed approximately 3/8 inch to a limit stop on valve plunger (35). The valve is held in this position when detent plunger (10), loaded by spring (11), registers with an annular groove on the valve plunger (35). During this stroking operation, the ball check (31) in the inlet port is unseated by displacement of pin (29) riding on chamfered portion of the plunger (35). Fluid will then flow from the hydraulic pressure source

S84-SD33-5I

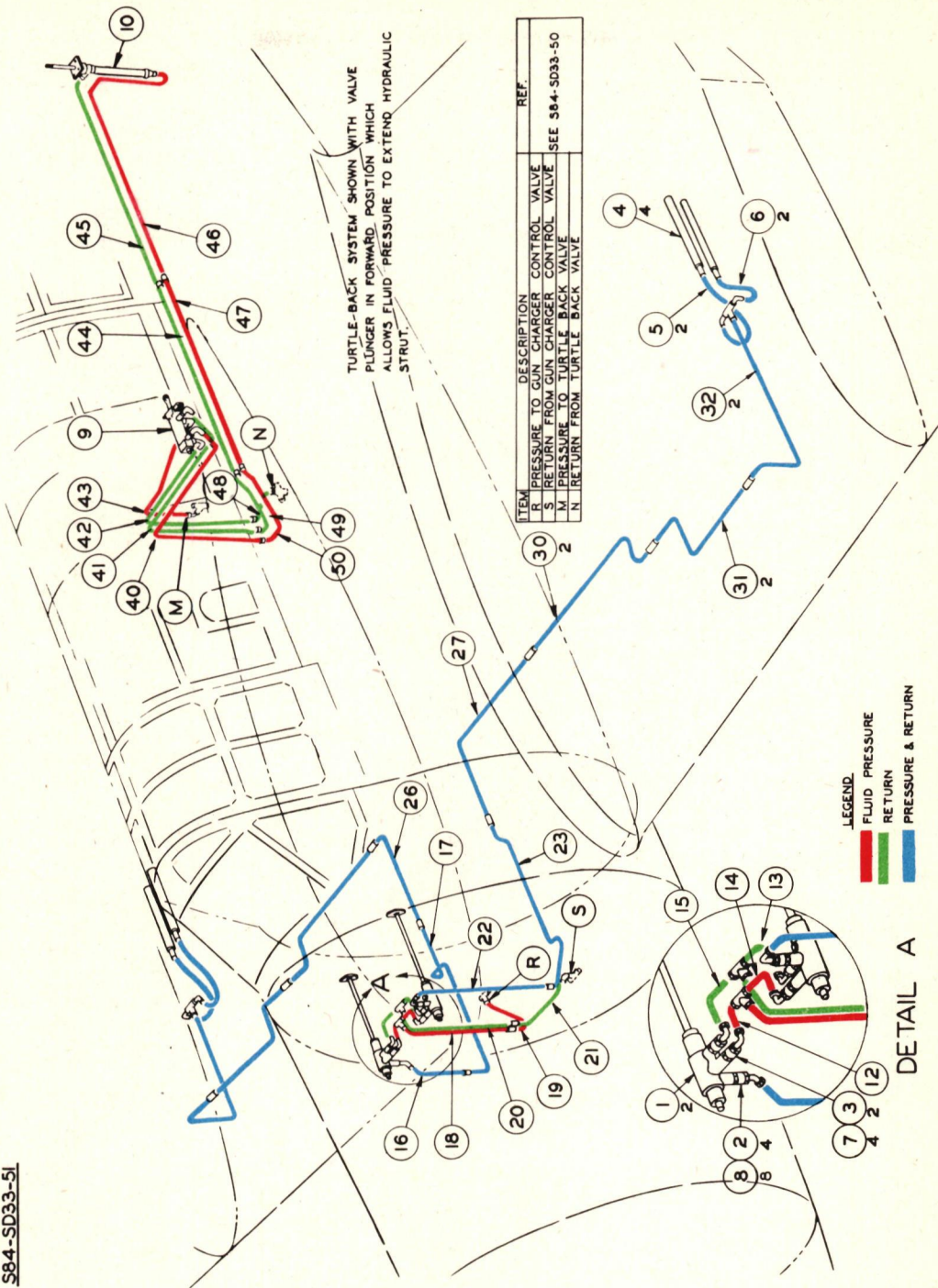


Figure 21-IX - Gun Charger and Turtleback Hydraulic System

PARTS LIST - GUN CHARGER AND TURTLEBACK
HYDRAULIC SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	2	Gun Charging Control Valve	S84-SD69-03A
2	4	Adapter	S84-33-852
3	2	Adapter	S84-33-851
4	4	Hydraulic Gun Charger	S84-SD33-35A
5	2	Hose Assembly	AN859-6-18
6	2	Hose Assembly	AN859-6-16
7	4	Gasket	AN901-6A
8	8	Gasket	AN901-8A
9		Turtleback Control Valve (Ref.)	S84-SD33-06A
10		Turtleback Retracting Strut (Ref.)	S84-SD33-02



LINE ASSEMBLIES - GUN CHARGER AND TURTLEBACK HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
12	S84-33-936-64	1	Pressure Line from Tee to Right-Hand Gun Charger Valve	3/8 x .035	10	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
13	S84-33-936-62	1	Return Line from Tee to Left-Hand Gun Charger Valve	3/8 x .035	5	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
14	S84-33-936-72	1	Pressure Line from Tee to Left-Hand Gun Charger Valve	3/8 x .035	5	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
15	S84-33-936-63	1	Return Line from Tee to Right-Hand Gun Charger Valve	3/8 x .035	8	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
16	S84-33-936-59	1	Pressure and Return Line from Pilot's Floor to Right-Hand Gun Charger Valve	3/8 x .035	14	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
17	S84-33-936-48	1	Pressure and Return Line from Pilot's Floor to Station 35.00	3/8 x .035	44	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
18	S84-33-936-60	1	Pressure Line from Pilot's Floor to Tee (Right-Hand)	3/8 x .035	17	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
19	S84-33-936-56	1	Pressure Line from Tee to Pilot's Floor	3/8 x .035	19	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
20	S84-33-936-61	1	Return Line from Pilot's Floor to Tee (Left-Hand)	3/8 x .035	18	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

LINE ASSEMBLIES - GUN CHARGER AND TURTLEBACK HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
21	S84-33-936-57	1	Return Line from Cross to Pilot's Floor	3/8 x .035	17	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
22	S84-33-936-58	1	Pressure and Return Line from Pilot's Floor to Left-Hand Gun Charger Valve	3/8 x .035	24	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
23	S84-33-936-27	1	Pressure and Return Line from Pilot's Floor to Station 35.00	3/8 x .035	43	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
26	S84-33-938-11	1	Pressure and Return Line from Station 35.00 to Center Panel (Right-Hand)	3/8 x .035	26.25	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
27	S84-33-938-42	1	Pressure and Return Line from Station 35.00 to Center Panel (Left-Hand)	3/8 x .035	38	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
30	S84-33-930-2L & 1R	1L Return from Station 31.75 to Station 80.38	Pressure Line and Return from Station 31.75 to Station 80.38	3/8 x .035	54.0	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
31	S84-33-930-10 & 1R	1L Pressure and Return Line from Station 80.38 to Station 102.00	Pressure and Return Line from Station 80.38 to Station 102.00	3/8 x .035	25	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6
32	S84-33-930-15 & 1R	1L Pressure and Return Line from Station 102.00 to Tee	Pressure and Return Line from Station 102.00 to Tee	3/8 x .035	29	Alum.AL. 52SO WW-T-787	AN818-6D AN819-6 AN818-6D AN819-6

LINE ASSEMBLIES - GUN CHARGER AND TURTLEBACK HYDRAULIC SYSTEM

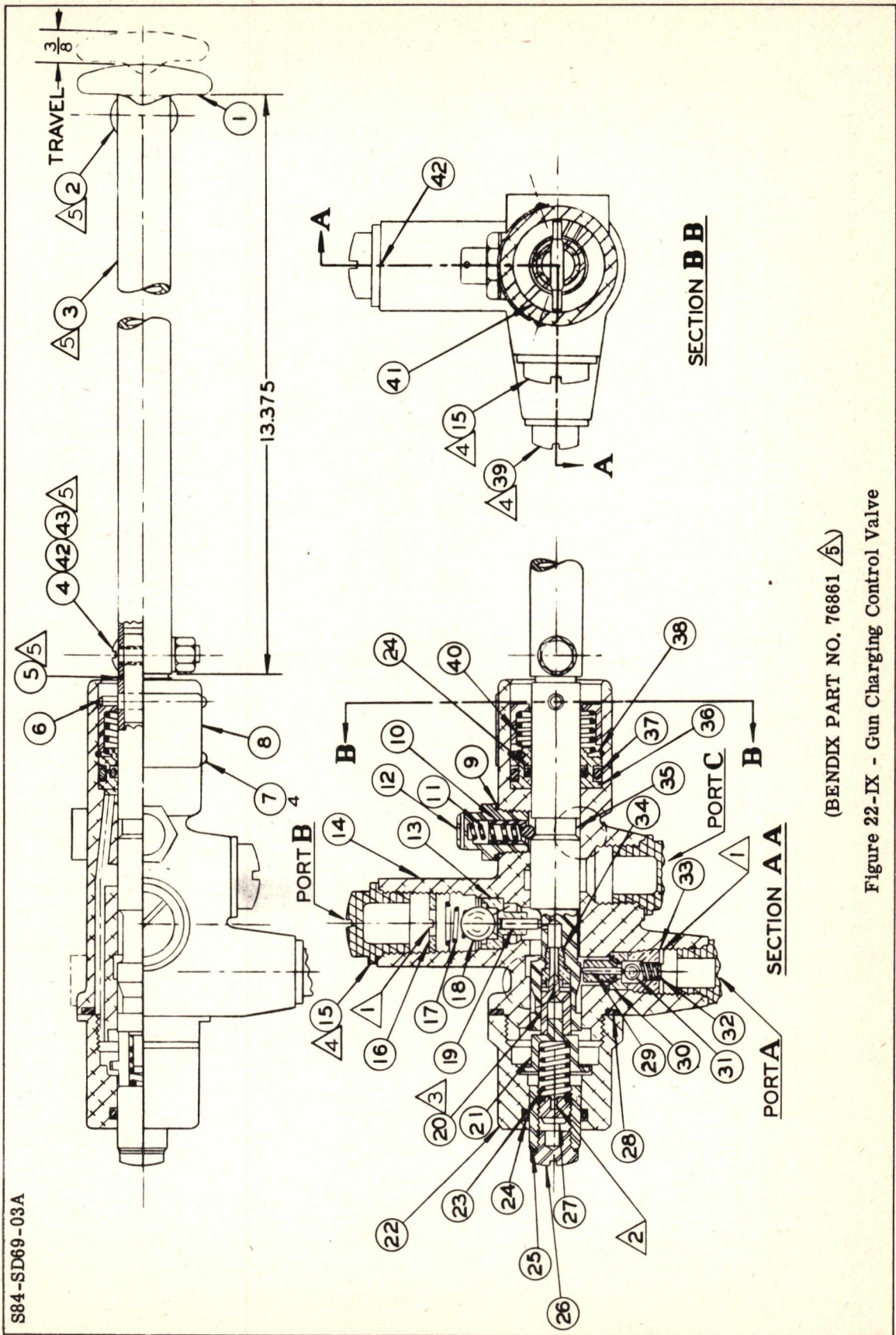
<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
40	S84-33-939-20	1	Pressure and Return Line from Top of Center Panel to Turtleback Valve	3/8 x .035	57	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
41	S84-33-939-21	1	Pressure and Return Line from Top of Center Panel to Turtleback Valve	3/8 x .035	57	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
42	S84-33-939-14	1	Return Line from Top of Center Panel Turtleback Valve	3/8 x .035	52	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
43	S84-33-939-15	1	Pressure Line from Connector to Turtle- back Valve	3/8 x .035	42	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
44	S84-33-939-28	1	Pressure and Return Line from Rear of Center Panel to Support	3/8 x .035	34	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
45	S84-33-939-5	1	Pressure and Return Line from Support to Upper Turtleback Strut Port	3/8 x .035	69	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
46	S84-33-939-4	1	Pressure and Return Line from Support to Lower Turtleback Strut Port	3/8 x .035	58	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
47	S84-33-939-27	1	Pressure and Return Line from Rear of Center Panel to Support	3/8 x .035	36	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

LINE ASSEMBLIES - GUN CHARGER AND TURTLEBACK HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
48	S84-33-939-557	1	Return Line from Top of Center Panel to Cross	3/8 x .035	10	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
49	S84-33-939-43	1	Pressure and Return Line from Bulkhead Fitting to Bulkhead Fitting	3/8 x .035	20	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
50	S84-33-939-44	1	Pressure and Return Line from Bulkhead Fitting to Bulkhead Fitting Rear of Bomb Bay (Right-Hand)	3/8 x .035	19	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

RESTRICTED

Section IX



(BENDIX PART NO. 76861 Δ 5)

Figure 22-IX - Gun Charging Control Valve

GUN CHARGING CONTROL VALVE

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Handle	78115
2	1	Rivet	671-D-AD-6-14 *
3	1	Tube	S84-33-554
4	1	Screw	AN526-DD1032-16 *
5	1	Adapter	S84-33-553
6	1	Pin-Handle	78117
7	4	Drive Screw-Name Plate	78652
8	1	Name Plate	79178
9	1	Gasket-Detent Cap Screw	174-S-7
10	1	Detent	78129
11	1	Spring Detent	78145
12	1	Cap Screw-Detent	78133
13	1	Valve Seat	78134
14	1	Housing	78109
15	2	3/4 Inch Plug	78149
16	1	Pilot-Spring Outlet	78153
17	1	Spring-Outlet Check Valve	78152
18	1	Ball-Outlet Valve	97-S-11
19	1	Pin-Outlet Check Valve	78128
20	1	Release Valve	78122
21	1	Stop-Release Valve	78116
22	1	End Cap	81591
23	1	Spring-Release Valve	81625
24	2	Seal	81589
25	1	Gasket-Cap Screw	78120
26	1	Cap Screw Plunger	78110
27	1	Screw-Spring Adjustment	78111
28	1	Rubber Gasket-End Cap	78138
29	1	Pin-Valve Inlet	78136
30	1	Valve Seat	78135
31	1	Ball-Inlet Valve	97-S-5
32	1	Spring-Check Valve Inlet	79602
33	1	Pilot-Check Valve Inlet	79601
34	1	Release Valve	78143
35	1	Plunger	78156
36	1	Seal Retainer	81592
37	1	Seal	81590
38	1	Snap Ring	78119
39	1	9/16 Inch Plug	78148
40	1	Spring -Plunger Return	78146
41	1	Assembly-Detent	78121
42	1	Nut	NAF-1137-D1032*
	1	3175-3-3D and Gasket #3175-2-8	
43	1	Washer	AN960-D10
		#3175-3-6D and Gasket #3175-2-6	

NOTES:

- ① Stake in place here after testing valve.
- ② Spread #78111 to insure locking in desired position.
- ③ Turn release valve No. 78122 and stake lightly in seat in several positions.
- ④ Plugs are for shipping purposes only and are to be removed when valve assembly is installed.
- ⑤ This drawing conforms to Bendix drawing 76861 except for parts noted.

NOTES:

- * Use on ships No. 41-18774 through No. 41-18789 only. On ships No. 41-18790 and up, use (1) AN526-1032-14 screw and (1) AAF364-1032 nut in place of (1) 671-D-AD6-14 rivet and (1) AN526-1032-14 screw in place of (1) AN526-DD1032-16 screw, and (1) AAF364-1032 nut in place of (1) NAF1137-D1032 nut.

6 Test Procedure:

(A.) Apply 1000 pounds per square inch to port A. With the handle left in the extended position there shall be no leakage at port B and port C.

(B.) Turn handle counterclockwise against the stop. Apply 1000 pounds per square inch to port B. There shall be no leakage at port A and port C.

(C.) Depress the handle until it latches in position. Plug port B. Apply pressure gradually to port A. The plunger should automatically release at 700 to 800 pounds per square inch. Increase the pressure to 1350 pounds per square inch. There should be no leakage other than port C.

(D.) Port C should not be plugged in any of the former tests. Apply 100 pounds per square inch (max.) to port C with port A and port B plugged. There shall be no external leakage.

through the inlet and cylinder port to the charger cylinder. The normal operating pressure on the charger cylinder will vary from 350 pounds per square inch to 600 pounds per square inch, depending on temperature conditions and characteristics of the particular gun to be charged. When the charger reaches the end of its stroke, the fluid pressure in the valve and charger cylinder will tend to increase to the maximum available pressure (approximately 1000 pounds per square inch).

(5) A release valve (20) in the plunger (35) is normally set by means of a spring (23) and adjusting screw (27) to open at approximately 800 pounds per square inch. The spring (23) is set to require this pressure at the small conical seat but, when the valve opens, the pressure will be effective upon the relatively larger area of the plunger (20), transmitting a force through the stop (21) to the cap (22), the reaction forcing the valve plunger (35) out of engagement with the detent plunger (10). As the plunger (35) returns to its normal position, ball check (31) is again seated, thereby sealing the hydraulic pressure source from the valve. The cylinder port is then open to the exhaust port, and, with the handle in firing position, fluid in the charger cylinder is free to flow back to the reservoir. If the same sequence is followed with the handle in safe position, the valve will close, but, since the ball check (18) is seated, fluid will be trapped in the charger cylinder, thereby holding the gun bolt retracted until the handle is again turned to the firing position.

(6) The ball check in the "IN" port should positively seal the hydraulic pressure when the plunger is in the extended position. Should leakage be evident which cannot be stopped by several successive charges to flush particles from the seat, the pilot (33) should be removed and the seat and ball thoroughly cleaned and inspected. Extreme care must be taken in removing the pilot as irreparable damage might be done to the threads in the port. It is recommended that the stake on the edge of the pilot be broken with a small drill before extraction of the pilot is attempted. Also, care must be exercised to prevent chips from falling into the valve.

(7) A scarred seat should be burnished with a tool of 7/64-inch spherical radius. If this fails, it will be necessary to replace the seat (30). Unless specialized tools and a guide are available to pull the damaged seat from the body and press in the new, it is recommended that the body be returned to Bendix Products Divisions, South Bend, Indiana, U.S.A., for repair.

(8) Should the "safety" ball check in the "CYL" port leak, the same procedure should be followed using a burnishing tool with a 7/32-inch spherical radius.

(9) If there is excessive leakage around the low pressure seal (37) in the body (14), the seal should be replaced. To replace the seal, the valve must be disassembled.

(10) If, after usage, the control valve requires a pronounced increase in the effort to actuate or does not return fully on the release stroke, it should be taken apart and cleaned. To disassemble, the following outlined procedure should be followed in the order given.

(11) The handle detent (41) should be depressed slightly, and the pin (6) pulled out. This will free the handle (1), the handle detent (41), and the spring (40). The detent cap screw (12), gasket (9), detent spring (11), and detent plunger (10) should then be removed. Spring pilot (16), spring (17), ball (18), and pin (19) of the cylinder port, spring pilot (33), spring (32), ball (31), and pin (29) of the inlet port should then be taken out. The cap (22) should then be removed, and the valve plunger (35) pulled out of the housing. If seal (37) is to be replaced, remove the lock ring (38) and seal retainer (36).

CAUTION: The hole for the pin (6) in the plunger must be thoroughly smoothed and any scratches that would mar the bore of the body must be removed before the plunger is pulled through the body.

(12) The valve plunger can be further disassembled by removing the cap screw (26), gasket (25), spring adjustment screw (27), the spring (23), the stop (21), and the release valve plunger (20). These parts should be carefully cleaned and inspected for burrs and score marks caused by the presence of dirt or abrasive matter in the system. If burrs are found on any of the moving parts, they should be stoned off until the part again moves freely. If deep score marks are found on the valve body bore, the body should be replaced.

(13) To assemble the valve plunger, the release valve plunger (20) is put in place, and the stop (21) and spring (27) are inserted. The spring adjustment screw (27) is then screwed in place. The gasket (25) and cap screw (26) need not be installed until kickout pressure is adjusted as described below. If the seal retainer (36) containing seals (24) and (37) has been removed, replace seals as required, re-install retainer (36), and lock in place with lock ring (38).

(14) The valve plunger (35) should then be assembled in the valve body (14). With gasket (28) in place, the end cap (22) should then be screwed in place. This operation should be done carefully to prevent damage to the plunger (35) and seals (24).

(15) The pin (29) of the inlet port should be inserted followed by the ball (31). The spring (32) is placed into the pilot (33) with the expanded end in the bore of the pilot. Screw this assembly against the seat (30) and stake the pilot into place after functional test.

(16) The pin (19) of the cylinder port should be inserted followed by the ball (18). The large end of the spring (17) is placed into the counterbore of the spring pilot (16). The assembly is then screwed in place and staked after functional test. Place the detent spring (11) into the bore of the detent plunger (10). This assembly is placed into the detent cap screw (12). Then the cap screw and assembled parts are screwed into place, making sure the gasket (9) is in place.

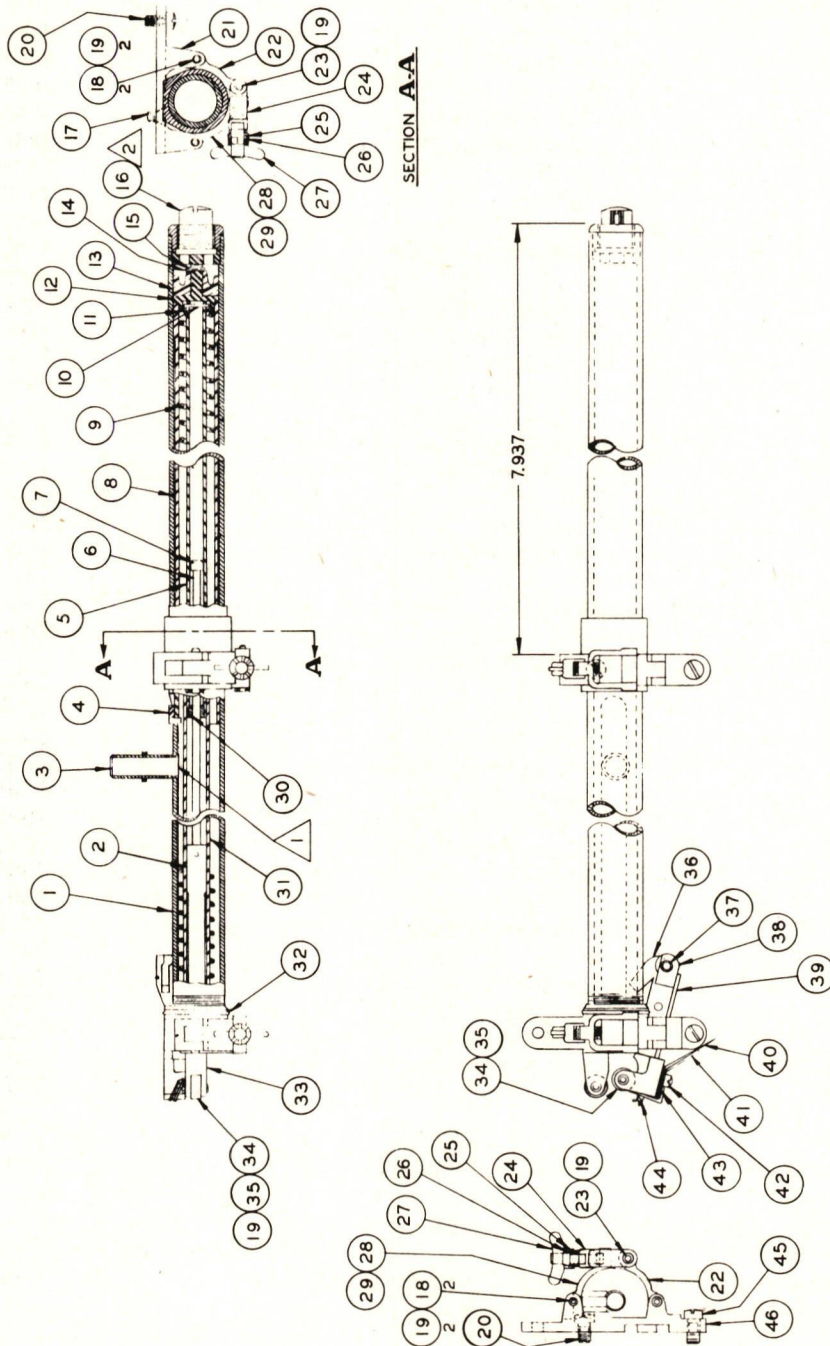
(17) Rotate the plunger in the body until the eccentric portion allows the ball in the "CYL" port to seat as shown in paragraph 5 of this section, fig. 22-IX. Install spring (40), detent (41), and handle with the red tip in line with the cylinder port. Depress the detent past the pin hole and insert pin (6). The valve is then ready for a functional test. Unless the repaired valve is immediately installed in the airplane, the ports should be plugged to prevent dirt from falling in the valve.

(18) After the valve has been reassembled, the spring (23) will require adjustment. This can be done in conjunction with either a hand pump or a power-operated pump with an adjustable relief valve. The valve should be put in the "OPEN" position and the pressure gradually increased until the valve plunger kicks out. The spring should be adjusted by the adjusting screw (27) in or out as required, until a kickout pressure of 500 pounds per square inch is obtained.

c. TROUBLE SHOOTING GUN CHARGING CONTROL VALVE.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Gun charges with charger handle in "EXTENDED" position.	(a) Faulty ball (31) or sticking pin (29). Broken spring (32) at inlet port "A."	1. Replace ball and burnish with burnishing tool having 7/64-inch radius. Rework pin and guide. Replace broken spring.

SB4-SD33-35A



(THIS DWG. CONFORMS TO BENDIX DWG. NO.76862)

Figure 23-IX - Gun Charging Unit

PARTS LIST - GUN CHARGER UNIT

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Cylinder Assembly	78035
2	1	Plunger Trip Mechanism	78046
3	1	Charging Pin	78064
4	1	Piston Lug	78051
5	1	Trip Pull Tube	78042
6	1	Pull Rod	78044
7	1	Pull Rod Collar	78045
8	1	Piston Tube	78049
9	1	Spring	78059
10	1	Pull Mechanism Pin	78047
11	1	Pull Mechanism Washer	78060
12	1	Piston End	78050
13	1	Piston Cup	78056
14	1	Piston Cup Retainer	78057
15	1	Piston Retainer Lock	78058
16	1	3/8 Plug	390215
17	1	Front Bracket Screw	78061
18	2	Cap Hinge Pin	78029
19	7	Cotter Pin (1/16 x 5/6)	112-S-22
20	2	Bracket Screw	78062
21	1	Front Bracket	78033
22	2	Bracket Cap (Lower)	78206
23	2	Clamp Hinge Pin	78030
24	2	Clamp	78022
25	2	Ratchet Lock	78020
26	2	Clamp Screw Spring	78019
27	2	Clamp Screw	78017
28	2	Bracket Cap (Upper)	78205
29	2	Bracket Cap Plug	78026
30	1	Trip Pull Bushing	78041
31	1	Spring Guide	78054
32	1	Locking Ring	78055
33	1	Cylinder End	78053
34	2	Trip Mechanism Bearing	78013
35	2	Bearing Pin	78014
36	1	Trip Mechanism Latch	78006
37	1	Trip Lever Pivot Pin	78007
38	1	Trip Lever	78009
39	1	Trip Lever Spring	78010
40	1	Trip Lever Spring	78011
41	1	Secondary Spring	79576
42	1	Spring Screw	78012
43	1	Spring Clip	79621
44	1	Lock Wire	78127
45	1	Bracket Screw	78063
46	1	Rear Bracket	78028

NOTES:



Assemble 78064 with end stamped "C" outside.



Plug for shipping only. Remove when unit is installed.

- | | | |
|---|---|---|
| (2) Plunger (35) will not stay in "DEPRESSED" position to charge gun. | (a) Detent (10) fouled or spring (11) broken. | 1. Rework detent, replace spring. |
| (3) Handle depressed, charger will not operate. | (a) Release valve (20) dirty or stuck in "OPEN" position. Spring adjusting screw (27) backed out too far. | 1. Remove valve (20) and free in sleeve. Using No. 500 lapping compound, lap valve body to sleeve and needle valve to seat. Replace spring if broken. Adjust screw (27) to proper tension for kick-out. |
| (4) Gun charged and "SAFE"; will not stay in "SAFE" position. | (a) Dirt under ball (18). Faulty ball (18). Broken spring (17). | 1. Disassemble and clean valve thoroughly. Replace ball and burnish with burnishing tool having a 7/32-inch spherical radius. Replace spring. |
| (5) Leak past seals (24) or (37). | (a) Faulty packing or scored shaft. | 1. Replace packing rings. Rework shafts. |

NOTE: Care will be used in the installation of pin in cylinder port. Rounded end must contact plunger. If reversed the pin may dig into plunger making it impossible to charge gun.

c. Hydraulic Charger (Bendix No. 76862).- The caliber .50 charger cylinder can be mounted, without parts alteration, on either the right-hand or left-hand side of the gun case.

(1) For right-hand mounting, the front and rear brackets should be mounted on gun as shown on fig. 23-IX, using four No. 10-32 screws in tapped holes already in the gun side plates. Install the flat-head screw in the top hole of the forward bracket. The three fillister-head screws should be safety wired and the flathead screw should be staked to prevent loosening.

(2) For left-hand mounting, the rear mounting bracket, with the latch mechanism in the same relation to the bracket, is reversed top for bottom. The front mounting bracket is mounted as shown on fig. 23-IX on either side of the gun.

(3) The bolt stud may be inserted into the gun bolt on either side by pulling the bolt back, aligning the hole with the circularly relieved portion of the side plate. The charging cylinder is located in the bracket as shown on fig. 23-IX, taking care that the locating and guide surfaces on the cylinder are properly positioned against the flat surfaces of the mounting brackets. The clamp caps should then be swung in place and the wing studs tightened. Wing studs should be hand-tightened only.

(4) The pivot points of the upper and lower caps may be interchanged by removing attaching pins, thereby permitting accessibility to wing studs from either above or below the gun.

(5) Hydraulic pressure is applied through the control valve to the charging cylinder, forcing the charging piston against the bolt stud and carrying the bolt back to the recoil position. The latch mechanism holds the bolt in this position until the fluid is exhausted from the charging cylinder, permitting the unimpeded return of the gun bolt. All air must be bled from charger line for satisfactory operation.

(6) Fig. 23-IX is a detail of the gun charger assembly No. 76862. Note that the assembly includes hydraulic cylinder assembly No. 78034. All parts of the cylinder are noted.

(7) When fluid under pressure enters the cylinder chamber, the piston moves rearward and engages bolt stud (3), thus retracting the gun bolt. Near the fully retracted position of the bolt, plunger (2), a part of the pull mechanism assembly, is pushed between the bearings (36), by the action of the piston. The bearing mounted at the end of the lever assembly, pivoted at the center, is moved by the plunger (2). This action rotates latch (38), mounted at the other

end of the lever assembly, in position to hold the bolt stud and bolt in the retracted position. The control valve then closes (see preceding description of control valve) and allows the piston return spring (9) to return the charger piston. The pull mechanism assembly has enough over-travel so that the piston has very nearly completed its return stroke when the plunger (2), between the bearings (36), begins to move. The lower bearing (36) will return to its former position, disengage the latch, and allow the bolt to return to its former position thereby completing the charging cycle.

(8) If the charger cylinder leaks excessively around the piston, the two piston seals (14) should be replaced. When disassembling, the charger should be removed from the gun and care exercised to keep all parts free of dirt or abrasives. If particles of dirt are permitted to get into the cylinder chamber, the highly polished walls may be scored and cause excessive seal wear and leakage.

(9) To disassemble, the locking ring (35) should be removed and the cylinder end assembly unscrewed. The spring (9) and the piston assembly can then be removed from the cylinder chamber and the piston seals (14) replaced.

(10) Before reassembly, all parts should be cleaned by washing in a good grade of gasoline. The cylinder end assembly should be placed into one end of the spring (9), while the pull mechanism assembly (5 etc.) is placed in the other end. Then the spring, together with these parts, is placed in the bore of the piston assembly (8 etc.). Next, the piston assembly is placed into the cylinder chamber (32), taking special care to guide the seals (14) into the chamber and past the end of the cylinder slot. If the seals are damaged during assembly, leakage will occur.

(11) If the latch assembly operates sluggishly, the parts should be carefully cleaned out and oiled. Unless the charger is immediately installed on a gun, the plug (16) should be placed in the port to prevent dirt from falling in the charger.

d. TROUBLE SHOOTING GUN CHARGING UNIT.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Charging valve handle depressed. Charging unit will not operate.	(a) Pressure too low.	1. Pressure must be above 800 pounds per square inch.
	(b) Latch mechanism binding.	2. Free and oil latch mechanism with specified oil.
(2) Charging valve handle depressed. Movement of charger sluggish.	(a) Dirt in gun charger cylinder.	1. Disassemble and clean thoroughly.
	(b) Packing faulty.	2. Install new packing.
	(c) Charger cylinder scored.	3. Replace gun charger.

6. Bomb Bay Door and Bomb Displacing Gear Hydraulic System.

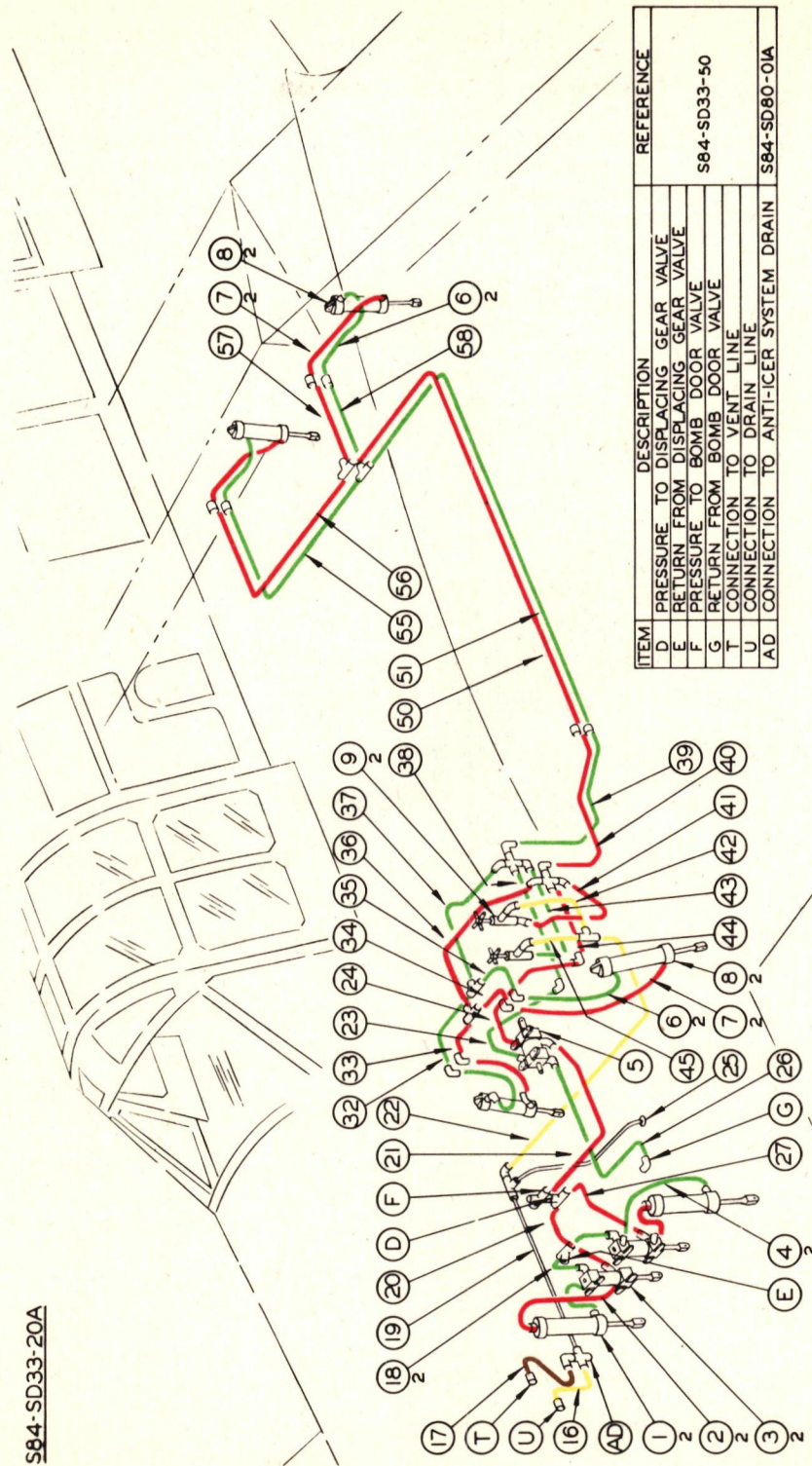
a. General.- The bomb bay doors and bomb displacing gear are operated hydraulically. The bomb door system opens and closes the bomb bay doors as required for release of bombs carried internally. The bomb displacing gear system swings released bombs clear of the airplane, and the gear then automatically retracts. The two systems are not connected together in any way but are closely related in function. The systems are shown in perspective on fig. 24-IX and in schematic form on fig. 25-IX.

b. Bomb Bay Door Hydraulic System.-

(1) Description.- The bomb bay door hydraulic system consists essentially of a control valve, two emergency dump valves, four strut assemblies, and the necessary lines and fittings. The control valve is located on the underside of the cockpit floor, its handle projecting through a slot in the floor at the left of the pilot's seat. A hydraulic strut is attached to the fuselage structure in the bomb bay near the fore and aft ends of each bomb bay door and the strut pistons are attached to fittings on the doors themselves.

(2) Normal Operation.- The mechanical features of the bomb bay doors are discussed in section II. Only the hydraulic action and the directly related mechanical action will be discussed here.

S84-SD33-20A



FLUID PRESSURE
 RETURN
 VENT
 DRAIN
 DRAIN & VENT

BOMB DOORS SYSTEM SHOWN WITH
 VALVE PLUNGER IN AFT POSITION
 DIRECTING FLUID PRESSURE TO BOTTOM
 SIDE OF PISTONS CLOSING BOMB DOORS.

DISPLACING GEAR SYSTEM SHOWN WITH
 VALVE PLUNGER AT DOWN POSITION.
 THIS IS CONDITION EXISTING WITH
 BOMBS IN PLACE AND PRESSURE ON
 TOP OF STRUT PISTONS.

Figure 24-IX - Bomb Doors and Displacing Gear Hydraulic System

PARTS LIST - BOMB DOORS AND DISPLACING GEAR HYDRAULIC SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	2	Displacing Gear Strut	S84-SD33-01
2	2	Hose Assembly	AN859-6-24
3	1L & 1R	Displacing Gear Valve	S84-SD33-05
4	2	Hose Assembly	AN859-6-21
5	1	Bomb Door Valve	S84-SD33-08
6	4	Hose Assembly	AN859-4D-16
7	4	Hose Assembly	AN859-4D-18
8	2L & 2R	Bomb Door Strut	S84-SD33-09
9	2	Drain Valves	S84-33-598



LINE ASSEMBLIES - BOMB DOORS AND DISPLACING GEAR HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
16	S84-33-936-74	1	Drain Line from Fire Wall to Cross	1/4 x .035	19.00	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
17	S84-33-936-501	1	Vent Line from Fire Wall to Cross	1/4 x .035	5.75	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
18	S84-33-936-35	2	Return Line-From Tee to Left-Hand Dis- placing Gear Valve From Tee to Right-Hand Displacing Gear Valve	3/8 x .035	8.00	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
19	S84-33-936-77	1	Drain and Vent Line from Cross to Tee	3/8 x .035	18.12	Alum.A1. 52SO WW-T-787	AN817-6D AN817-6D
20	S84-33-936-33	1	Pressure Line From Tee Under Wing Fold Valve to Right-Hand Dis- placing Gear Valve	3/8 x .035	16.00	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
21	S84-33-936-24	1	Pressure Line From, Bomb Door Valve to Cross on Bottom of Wing Fold Valve	3/8 x .035	31.00	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
22	S84-33-936-69	1	Drain Line From Bomb Door Drain Valves to Tee	1/4 x .035	54.00	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
23	S84-33-936-23	1	Pressure and Return Line Inboard from Sta. 35.00 to Bomb Door Valve	3/8 x .035	14.00	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
24	S84-33-936-22	1	Pressure and Return Line Outboard From Sta. 35.00 to Bomb Door Valve	3/8 x .035	14.00	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

LINE ASSEMBLIES - BOMB DOORS AND DISPLACING GEAR HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
25	S84-33-936-47	1	Drain and Vent Line From Tee Through Skin	3/8 x .035	11.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
26	S84-33-936-26	1	Return Line From Tee to Bomb Door Valve	3/8 x .035	27.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
27	S84-33-936-34	1	Pressure Line From Tee under Wing Fold Valve to Left-Hand Displacing Gear Valve	3/8 x .035	17.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
32	S84-33-938-32	1	Pressure and Return Line From Sta. 35.00 to Tee (Right-Hand)	3/8 x .035	10.31	Alum.AL 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
33	S84-33-938-31	1	Pressure and Return Line From Sta. 35.00 to Tee (Right-Hand)	3/8 x .035	5.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
34	S84-33-938-29	1	Pressure and Return Line From Sta. 35.00 to Tee (Left-Hand)	3/8 x .035	5.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
35	S84-33-938-30	1	Pressure and Return Line from Sta. 35.00 to Tee (Left-Hand)	3/8 x .035	6.50	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
36	S84-33-938-28	1	Pressure and Return Line From Tee to Cross (Left-Hand)	3/8 x .035	15.68	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
37	S84-33-938-27	1	Pressure and Return Line From Tee to Cross (Left-Hand)	3/8 x .035	13.12	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

LINE ASSEMBLIES - BOMB DOORS AND DISPLACING GEAR HYDRAULIC SYSTEM

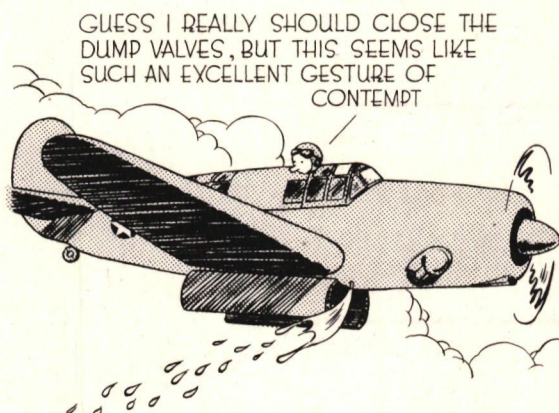
<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
38	S84-33-938-25	1	Pressure and Return Line Inboard From Sta. 35.00 to Cross	3/8 x .035	4.12	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
39	S84-33-938-35	1	Pressure and Return Line From Cross to Center Panel Support (Left-Hand)	3/8 x .035	30.12	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
40	S84-33-938-36	1	Pressure and Return Line From Cross to Center Panel Support (Left-Hand)	3/8 x .035	30.12	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
41	S84-33-938-21	1	Line From Bomb Door Drain Valve to Cross	1/4 x .035	9.38	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
42	S84-33-938-20	1	Drain Line From Bomb Door Drain Valve to Tee	1/4 x .035	8.25	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
43	S84-33-938-22	1	Line From Bomb Door Drain Valve to Cross	1/4 x .035	7.75	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
44	S84-33-938-26	1	Pressure and Return Line Outboard From Sta. 35.00 to Cross	3/8 x .035	3.25	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
45	S84-33-938-19	1	Drain Line From Bomb Door Drain Valve to Tee	1/4 x .035	5.19	Alum.A1. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
50	S84-33-930-55	1	Pressure and Return Line From Support S84-33-897 to Tee	3/8 x .035	51.25	Alum.A1. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6

LINE ASSEMBLIES - BOMB DOORS AND DISPLACING GEAR HYDRAULIC SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
51	S84-33-930-56	1	Pressure and Return Line From Support S84-33-897 to Tee	3/8 x .035	51.00	Alum.AL. 52SO WW-T-787	AN818-6D AN818-6D AN819-6 AN819-6
55	S84-33-939-49	1	Pressure and Return Line From Tee to Support Rear Bomb Bay (Right-Hand)	1/4 x .035	31.50	Alum.AL. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
56	S84-33-939-46	1	Pressure and Return Line From Tee to Support Rear Bomb Bay (Right-Hand)	1/4 x .035	31.00	Alum.AL. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
57	S84-33-939-48	1	Pressure and Return Line From Tee to Support Rear Bomb Bay (Left-Hand)	1/4 x .035	9.38	Alum.AL. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
58	S84-33-939-47	1	Pressure and Return Line From Tee to Support Rear Bomb Bay (Left-Hand)	1/4 x .035	11.00	Alum.AL. 52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4

Refer to fig. 25-IX. When the bomb door control lever is placed in the "CLOSED" (aft) position, the control valve plunger is placed in the full aft position, as shown in the upper portion of detail "A." With the plunger in this position, fluid under pressure from the main hydraulic system is directed through the lines to the bottom ports of the four actuating struts, retracting the pistons and closing the bomb bay doors.

When the bomb door control lever is placed in the "OPEN" (forward) position, the control valve plunger is placed in the full forward position, as shown in lower portion of detail "A." With the plunger in this position, fluid under pressure from the main hydraulic system is directed through lines to the top ports of the four actuating struts, extending the pistons and opening the bomb bay doors. If accumulator power is not available, the bomb bay doors may be opened or closed hydraulically by setting the bomb door control lever and operating the hydraulic hand pump.



(3) Emergency Operation.- For emergency operation, when hydraulic pressure cannot be obtained, the bomb bay doors may be opened by opening the two dump valves (item 9, fig. 25-IX) which are located at the left of the pilot's seat. This will allow the struts to drain, permitting the pistons to move freely, and the bomb bay doors will be opened by a shock cord arrangement which is always under tension. The dump valves should be closed immediately after the doors open to prevent excessive loss of hydraulic fluid, which will drain outside the airplane as long as the valves are open. The position of the bomb door control lever and valve will have no effect upon the emergency opening of the bomb bay doors in this manner unless there is

some hydraulic pressure in the system. It is advisable, however, to place the control lever in the "OPEN" position before the dump valves are opened. No emergency method is provided for closing the bomb bay doors.

(4) Bomb Bay Door Control Valve.-

(a) Description.- Fig. 26-IX is a detail of the bomb bay door control valve. The principal parts of the valve are the body and plunger. The plunger is hollow, with plugged ends, and holes are drilled at two points, as shown, to allow fluid to flow through the hollow portion. Cup-type seals are provided around each end of the plunger. Each seal is held in place by a cap attached to the body with four screws.

(b) Disassembly, Minor Repair, and Assembly.- Disassembly procedure should be obvious from fig. 26-IX. To replace seals, first remove the operating levers (5 and 6); then remove the end caps by taking out the attaching screws. Seals should be easily dislodged with the plunger. The plunger is lapped to fit the body and therefore should be handled with extreme care.

Before installing new packing or seals, remove all traces of old packing or seals, clean parts thoroughly and allow to dry. Lubricate seals thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing. Use ample approved anti-seize compound when installing threaded fittings in the body, Specification No. AN-C-53.

(5) Bomb Bay Door Actuating Struts.-

(a) Description.- The four bomb bay door actuating struts are identical. Fig. 27-IX is a detail of the strut. The strut is conventional.

(b) Disassembly, Minor Repair and Assembly.- Replacement of any of the seals or packing requires removal of the cylinder cap (4). To remove the cap, first loosen the setscrew; then unscrew the cap (4) and withdraw the piston (2) from the cylinder (1). At this stage, all of the seals except the piston rod seal (5) may be replaced. To replace the piston rod seal, it is necessary to loosen the lock nut (8), unscrew the eyebolt (7), and withdraw the piston rod from the cap (4).

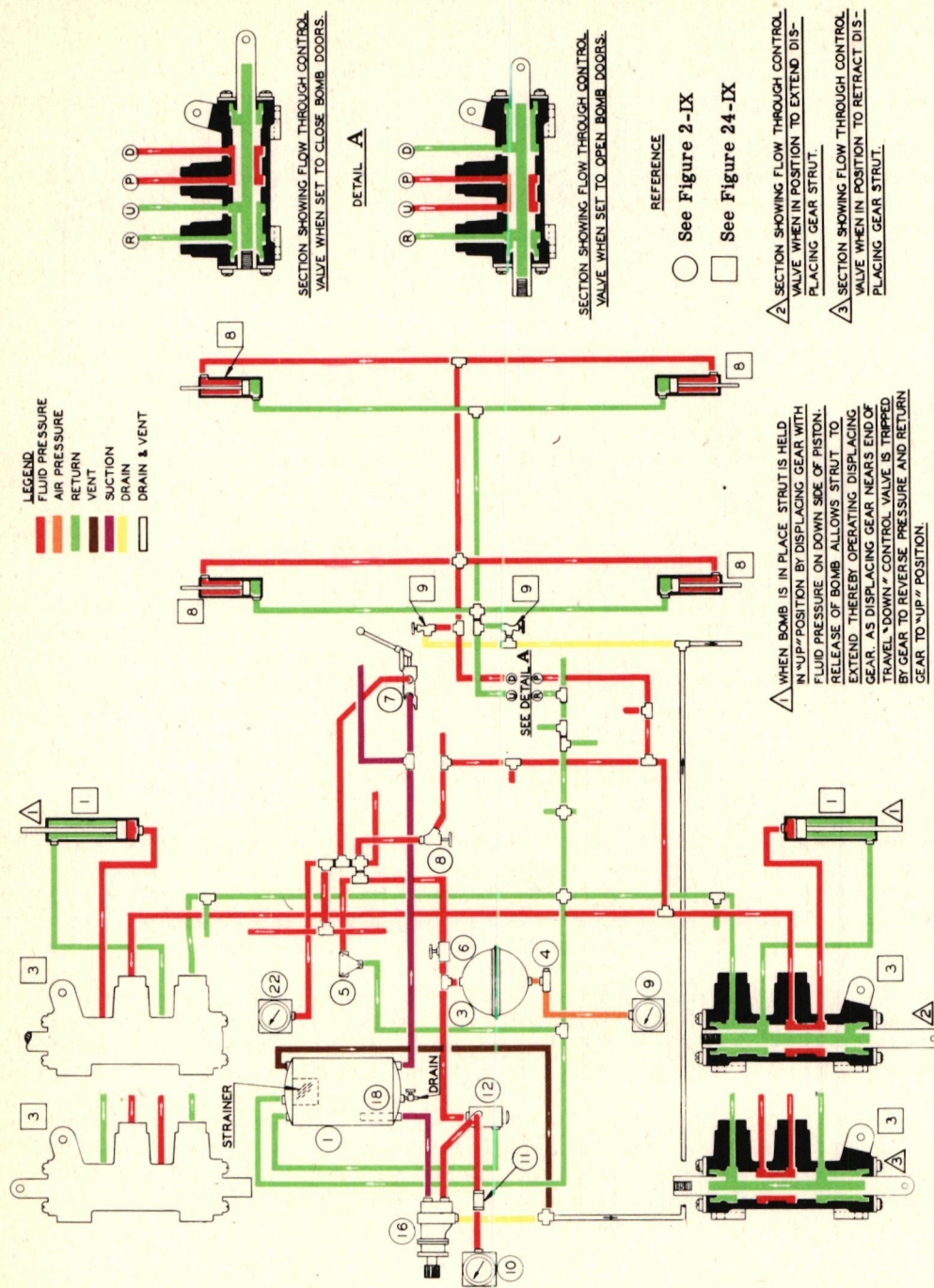


Figure 25-IX - Bomb Doors and Displacing Gear Schematic

NOTES:

- ① Lock wire required as shown.
 2. Use Specification No. AN-VV-O-366a hydraulic fluid.
 3. Plug ports "B" "C" and "D." Apply 1500 pounds per square inch for five minutes at port "A" with plunger in position shown. No leakage should result.
 4. Plug port "C." Apply 1500 pounds per square inch for five minutes at port "B" with plunger in position shown. Leakage at ports "A" and "D" should not exceed 50 drops per minute when minimum fluid temperature is 130 degrees F.
-

Before installing new seals, remove all traces of old seals; clean parts thoroughly and allow to dry. Lubricate all seals thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing. When installing piston rod seal (5), exercise care when inserting the piston rod through the cap and seal. See paragraph 6 of this section.

At reassembly, adjust cap (4) to give specified piston stroke and install locking plug (9) and setscrew. Tighten setscrew as specified on drawing. Adjust eyebolt (7) to give specified extended or retracted length shown on drawing and lock in place with nut (8). Use ample approved anti-seize compound when installing threaded fittings in the strut body, Specification No. AN-C-53.

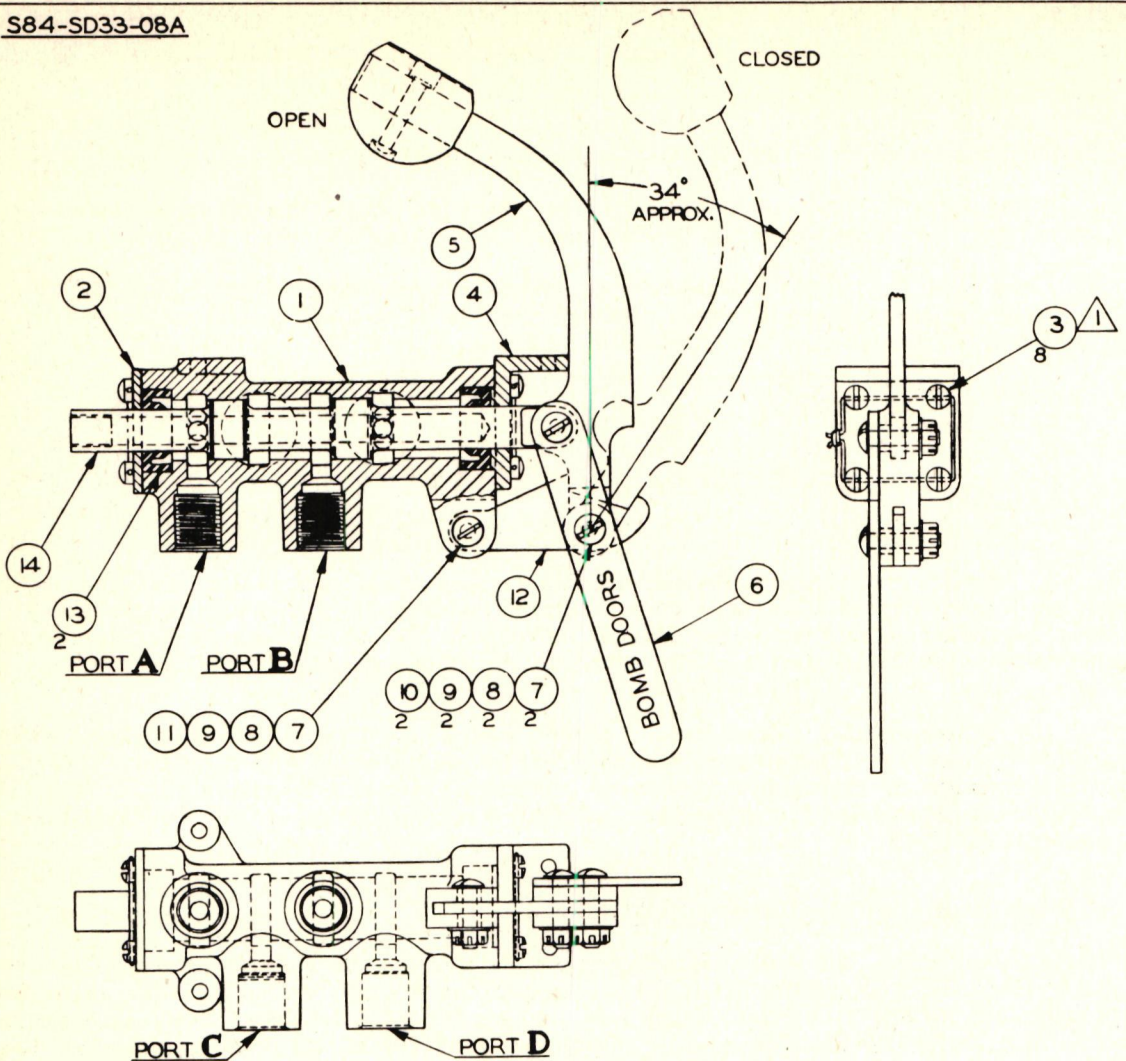
c. Bomb Displacing Gear Hydraulic System.-

(1) Description.- The bomb displacing gear hydraulic system consists essentially of two control valves and two actuating struts. A mechanical control is provided for each valve, but it is utilized in loading the bombs and not in normal operation of the displacing gear, which is automatic following release of bomb(s). The piston of each actuating strut is connected to a main displacing gear arm. A single or double (forked) type auxiliary arm is attached to each of two main arms, depending upon the size of the bomb(s) to be carried. Two single auxiliary arms are required for one 1000-pound or larger bomb, while one double auxiliary arm is required for each 500-pound bomb. When the bombs are loaded in the bomb racks, spring-loaded sockets at the ends of the auxiliary arms are engaged with projections on the sides of the bombs. Before bombs are loaded, the main hydraulic shut-off valve (item 8, fig. 1-IX) must be closed to allow manual adjustment and attachment of the bomb displacing gear. The mechanical control for each displacing gear valve is combined with a latch which the arresting gear engages when it returns automatically to the "UP" position after the bombs are dropped. The latches and control levers are located on the forward bomb bay bulkhead. Each control lever is connected by a cable to a spring-loaded, dead-center bell crank incorporated with each displacing gear control valve. When the control levers are moved inboard, the latches are released, and the control valves are positioned to extend the displacing gear.

(2) Operation.- For a thorough understanding of the displacing gear operation, it is advisable to consider a complete cycle of operation. Assume that no bombs are in the bomb bay and that the displacing gear arms are locked in the fully retracted position by the "UP" latches. Before the bombs are loaded, the bomb bay doors will be opened and the main hydraulic shut-off valve (item 8, fig. 1-IX) will then be closed to shut off accumulator pressure. The displacing gear arms should be supported, the latches released, and the arms lowered.

After the bomb or bombs are suspended from the bomb racks, the arms are raised, and the ends engaged with the projections on the sides of the bombs.

S84-SD33-08A



Ref. No.	Quantity	Item	Part No.
1	1	Body	S84-33-527
2	1	End Cap	S84-33-650
3	1	Screw	AN302-10-8
4	1	Head	S84-33-042
5	1	Lever Assembly	S84-33-159
6	1	Handle	S84-33-158
7	3	Cotter Pin	AN380-C2-2
8	3	Nut	AN320-3
9	3	Washer	AN960-10L
10	2	Bolt	AN23-16
11	1	Bolt	AN23-13
12	1	Link	S84-33-541
13	2	Packing	1145-D-531
14	1	Plunger Assembly	S84-33-513

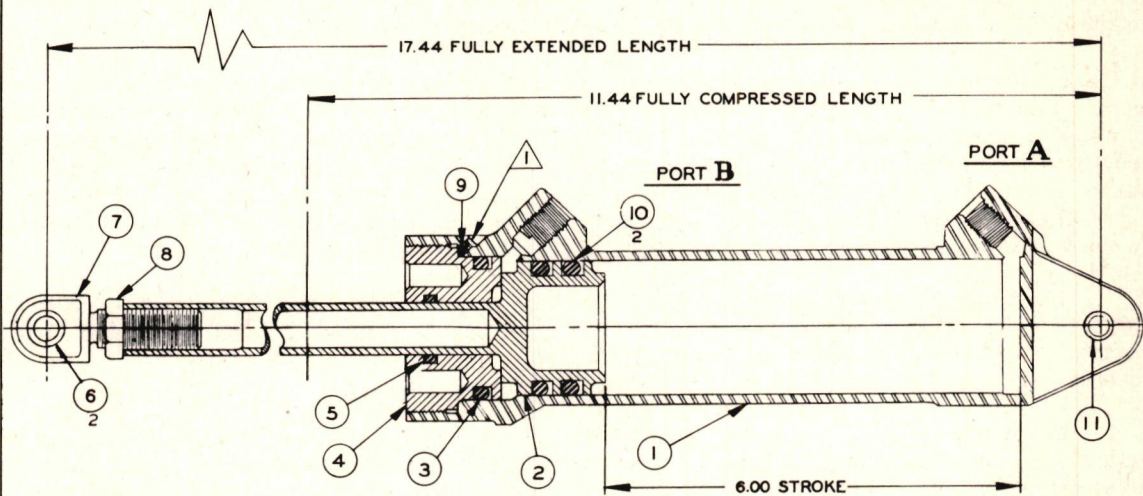
NOTES:

△ Lock wire required as shown.

(C.W. ASSEMBLY S84-33-504)

Figure 26-IX - Bomb Door Control Valve

S84-SD33-09A



(C.W. ASSEMBLY S84-33-960)

PARTS LIST - BOMB DOOR RETRACTING STRUT

Ref. No.	Quantity	Item	Part No.
1	1	Cylinder	S84-33-591
2	1	Piston	S84-33-858
3	1	Packing	AN6227-30
4	1	Cap	S84-33-859
5	1	Packing	AN6227-15
6	2	Bushing	1001-D-6-1875
7	1	Screw	S84-33-094
8	1	Nut	S84-33-157
9	1	Plug	S84-33-529-2
10	2	Packing	AN6227-29
11	1	Bushing	1001-D-4.240

NOTES:

1. No 8-32 setscrews flat point (.25 long) set in place by hand pressure on long arm of standard "Allen" head wrench No. 8. Pressure must be sufficient to lock S84-33-859 cap securely in place.
2. Bursting test - Apply 2500 pounds per square inch to ports "A" and "B" simultaneously.
3. Apply 1500 pounds per square inch pressure at port "A"; leakage past piston shall not exceed five drops per minute. There shall be no external leakage.
4. Use same procedure at port "B."
5. Use hydraulic fluid, Specification No. AN-VV-O-366a.
6. For additional testing information, see Curtiss Specification No. S-345.

Figure 27-IX - Bomb Door Retracting Strut

After all operations relating to the bomb loading are completed, the displacing gear control valve levers are each placed in the inboard position, and the main shut-off valve (item 8, fig. 1-IX) then opened. The plunger of each control valve is now in the extended position as shown connected into the system on fig. 25-IX. With the plungers in this position, pressure from the hydraulic system is applied through the top ports of the actuating struts. The displacing gear, however, is prevented from extending by the bombs themselves until they are released. When the bombs are released, the actuating struts force the displacing gear immediately to the fully extended position to swing the bombs clear of the airplane.

However, as the displacing gear attains the fully extended position, it trips the dead-center bell crank of each valve control mechanism to place the valve plungers in the retracted position as shown on note 3 of fig. 25-IX. With the plungers in this position, fluid under pressure from the main hydraulic system is directed through lines to the bottom ports of the actuating struts to retract the strut pistons and the attached displacing gear. As the arms of the gear attain their fully retracted position, they engage the spring-loaded "UP" latches and are locked in the retracted position until released manually by moving the latch levers inboard.

(3) Displacing Gear Control Valve.- Fig. 28-IX is a detail of the displacing gear control valve. Two identical valves are employed. The valve is similar to the bomb bay door control valve, and reference is made to information given on the latter valve for service instructions.

(4) Displacing Gear Actuating Strut.- Fig. 29-IX is a detail of the displacing gear actuating strut. Four identical struts are employed. The strut is similar to the bomb bay door actuating strut, and reference is made to information given on the latter strut for replacement of packing.

(5) Operations for Adjusting Displacing Gears.-

(a) The clevis adjustment on the piston strut of 84-33-507 hydraulic cylinder should be adjusted so that the piston will not bottom in the cylinder when the displacing gear is retracted. Otherwise, the piston strut will be compressed between the displacing gear and bottom of the hydraulic cylinder, when the displacing gear reaches the bungee, to such an extent that the piston strut will buckle and consequently be ruined.

(b) This measurement can be obtained by pushing the piston into the hydraulic cylinder until it bottoms. Adjust the clevis on the piston strut until the distance between the bottom of the hydraulic cylinder housing and the center line of the bolt hole in clevis is 1.75 inch. This will give a safety factor of approximately .125 inch between end of piston and cylinder at end of the "UP" travel of the displacing gears.

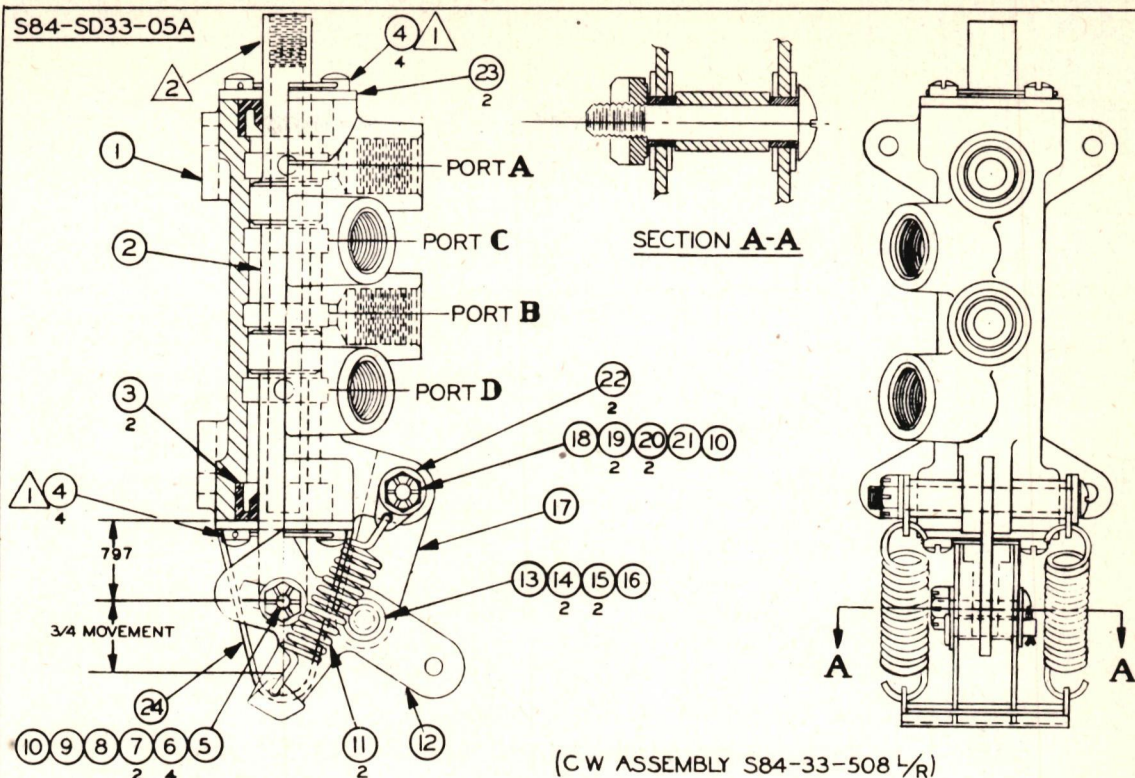
(c) Before connecting the displacing gears to the piston struts, work the displacing gears up and down to make sure they do not bind at any point. If the displacing gears do not move upward freely until they hit the bungee, they are probably binding between the 84-70-513 socket and the 84-70-523 supports.

(d) Better and safer results can be obtained if the 1000-pound displacing gear is not used in this check out. With the 500-pound displacing gears, minus the arms, the displacing gears can be moved individually, and the displacing gears can be cycled without danger of injury to the hands, when the latches are tripped at station 30 bulkhead.

(e) After connecting the displacing gears to the piston struts and installing the 84-70-542 L/R rod assemblies, the next step is to adjust the rod assemblies to the displacing gears so they will have a down travel of 85 degrees. Lower the displacing gears and, using a protractor and a wax pencil, mark off on the displacing gear doors 75 degrees and 85 degrees down travel. The starting point should be 75 degrees because there are variations in the retraction of the displacing gears after the selector valves have been tripped to retract the displacing gears. Adjust the rod assemblies so the selector valves will be tripped at the 75 degree point.

NOTE: Under no conditions are the displacing gears to be cycled without restrictor fittings in the hydraulic system. These fittings are located at port "D" on displacing gear control valve.

S84-SD33-05A



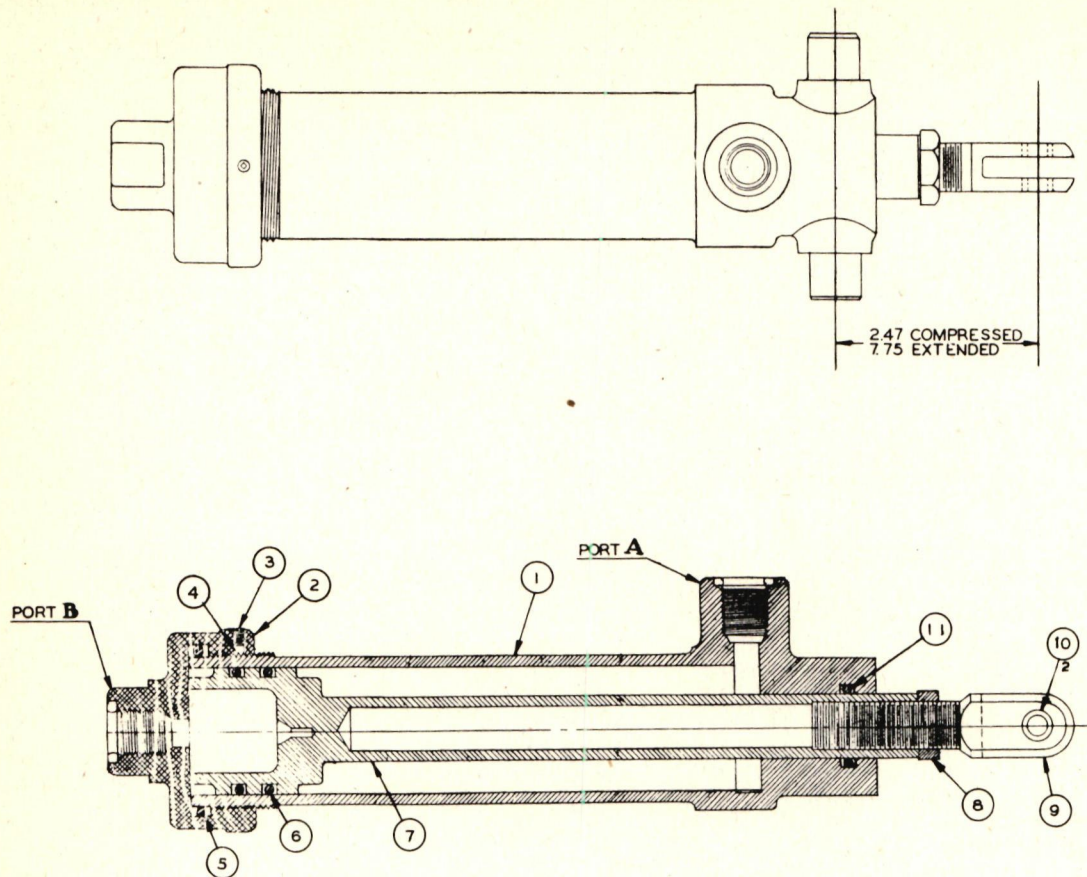
Ref. No.	Quantity	Item	Part No.
1	1L or 1R	Body	S84-33-543
2	1	Plunger Assembly	S84-33-526
3	2	Packing	1145-D-.531
4	8	Screw	AN502-10-8
5	1	Bolt	AN23-17
6	4	Washer	S84-33-876
7		Spacer	S84-33-875
8	1	Bushing	1001-D-3-.492
9	1	Nut	AN320-3
10	2	Cotter Pin	AN380C2-2
11	2	Spring	S84-33-044
12	1	Trip Assembly	S84-33-868
13	1	Pin	AN393-25
14	2	Washer	AN960-10L
15	2	Spacer	1001-D-3-.218
16	1	Cotter Pin	AN380C2-2
17	1	Support Assembly	S84-33-867
18	1	Bolt	AN24-34
19	3	Washer	AN960-416
20	2	Spacer	1025D-375-531
21	1	Nut	AN320-4
22	2	Spring Tab	S84-33-365
23	2	End Cap	S84-33-650
24	1	Bracket	S84-33-864

NOTES:

① Lock wire required as shown.

② This end of plunger S84-33-526 must not come below outer face of end cap S84-33-650 during operation. Also plunger must not extend beyond outer face of end cap more than .781 during operation.

Figure 28-IX - Displacing Gear Control Valve



<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Cylinder	S84-33-668
2	1	Caps	S84-33-718
3	1	Setcrew Allen	No. 8-23 x .25
4	1	Plug	Hollow Fl. Pt.
5	1	Packing	S84-33-529-2
6	2	Packing	AN6230-2
7	1	Piston	AN6227-23
8	1	Nut	S84-33-717
9	1	Clevis End	S84-33-157
10	2	Bushing	S84-33-363-1
11	1	Packing	1001-D-4-.156
			AN6227-15

(C.W. ASSEMBLY S84-33-999)

Figure 29-IX - Displacing Gear Retracting Strut

(f) Cycle the displacing gears individually and, by standing to one side, observe to see at what point the displacing gears reach before they retract. If they do not reach the 85 degree mark, they must be adjusted until they do.

(g) After this adjustment has been obtained, the cables from the hatches to the bell cranks are adjusted by means of the turnbuckle, until the slack has been removed. The cables are not to be under any tension. After the displacing gear arms have been installed, the ship is then ready to drop-test the bombs.

7. Turtleback Hydraulic System.

a. Description.- The turtleback aft of the turret may be collapsed hydraulically to permit greater firing range of the turret gun. The sections of the turtleback are hinged longitudinally and are supported by an umbrella-type strut arrangement which, in turn is operated by a hydraulic strut. The hydraulic strut is controlled by a two-piston valve which is mounted on the upper radio shelf near the center line of the airplane. Operating pressure is obtained from the main hydraulic system, but is subject to control by both shut-off valves, item 8 of fig. 1-IX. The turtleback hydraulic system is shown in schematic form on fig. 30-IX.

b. Operation.- Pulling the handle of the control valve aft causes the turtleback to collapse, and vice versa.

c. Control Valve.- Fig. 31-IX is a detail of the turtleback control valve. The principal parts of the valve are the body and plunger. Cup-type seals are provided around each end of the plunger. Each seal is held in place by a cap attached to the body with four screws.

To replace seals, first disconnect the operating lever (7) from the plunger (4), then remove the end caps (2 and 6) by taking out the attaching screws. Seals should be easily dislodged by the plunger. The plunger is lapped to fit the body and therefore should be handled with extreme care.

Before installing new seals, remove all traces of old seals, clean parts thoroughly and allow to dry. Lubricate seals thoroughly with Specification No. AN-VV-O-366a, hydraulic fluid, before installing. Use ample approved thread lubricant when installing threaded fittings in the body Specification No. AN-C-53.

d. Retracting Strut.- Fig. 32-IX is a detail of the turtleback retracting strut. The strut is conventional and disassembly procedure should be obvious from the drawing. Note that the stroke is controlled by the position of the end cap (4) and should be as shown on the drawing.

Before installing new packing or seals, remove all traces of old packing or seals; clean parts thoroughly and allow to dry. Lubricate all seals or packing thoroughly with Specification No. AN-VV-O-366a, hydraulic fluid, before installing. When installing piston rod seal (2), exercise care in inserting the piston rod through the cap and seal. When assembling threaded fittings in the cylinder, use ample approved thread lubricant, Specification No. AN-C-53.

8. Turret Hydraulic System.

a. General.- The turret hydraulic system comprises equipment for operating the turret, elevating and depressing the turret gun, and charging all of the guns. All of the equipment comprising the turret hydraulic system, including the gun charging units, is installed within the turret. (The wing gun charging equipment is located in the pilot's cockpit and the wings.)

b. Turret Hydraulic System.-

(1) Description and Operation.- The system is shown schematically on fig. 30-IX. Hydraulic pressure for operating the turret is obtained through a swivel from the main hydraulic system, which is shown on figs. 1-IX and 30-IX. The swivel is shown on fig. 34-IX. This unit is installed at the bottom of the turret on the rotational axis, and provides hydraulic pressure, return lines, and electric power connections for the turret. The unit also includes a micro-switch and profile cam that serve as a fire-interrupter in the gun trigger circuit to prevent firing into the airplane.

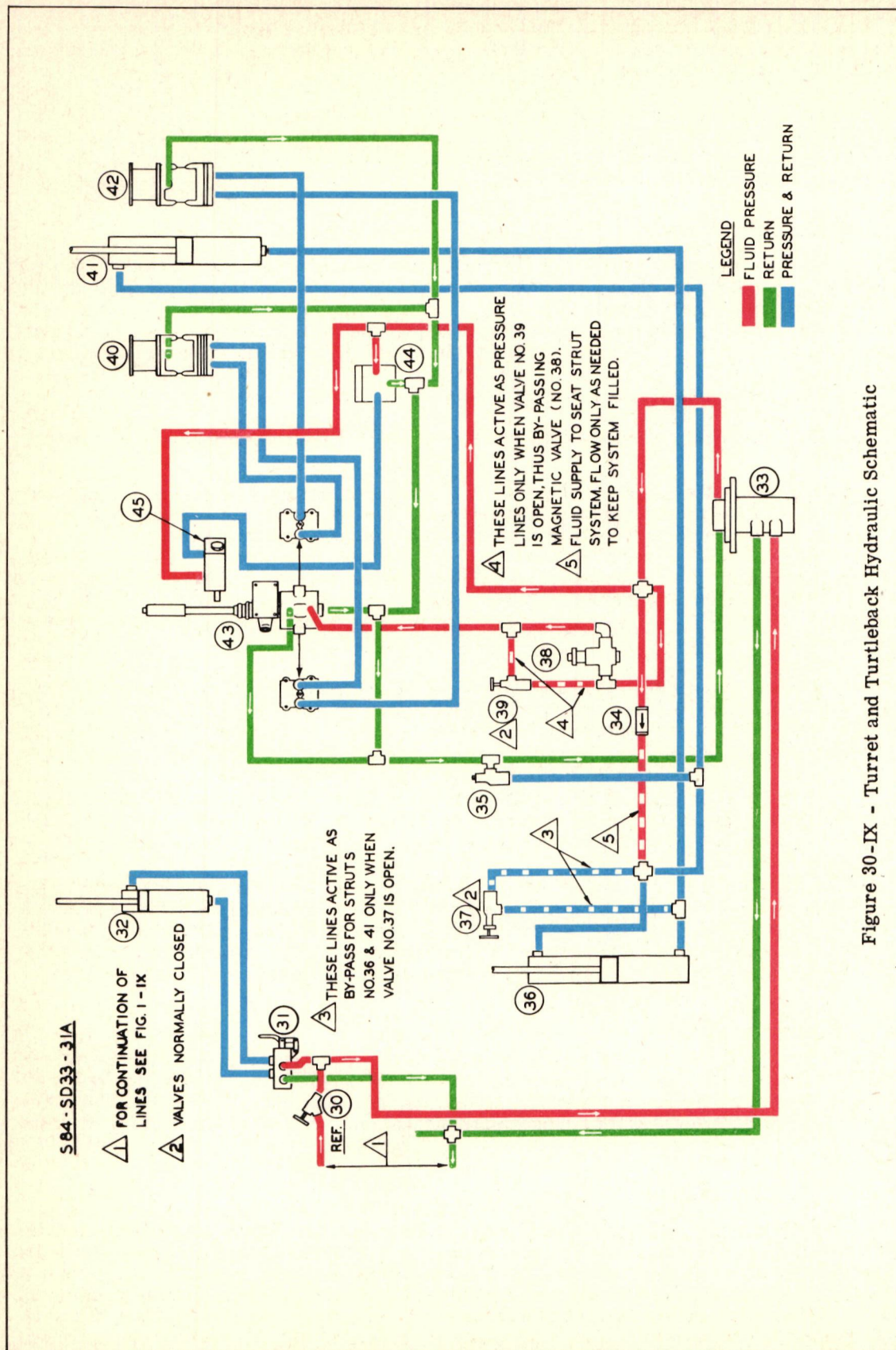


Figure 30-IX - Turret and Turtleback Hydraulic Schematic

PARTS LIST - TURRET AND TURTLEBACK HYDRAULIC SCHEMATIC

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
30		Turret Shut-Off Valve (Ref.)	S84-SD33-50
31		Turtle Deck Control Valve (Ref.)	S84-SD33-06
32		Turtleback Retracting Strut (Ref.)	S84-SD33-02
33		Swivel Assembly (Ref.)	S84-SD66-01
34	1	Check Valve	Bendix 2207-A11
35	1	Relief Valve	S84-33-950
36		Seat Elevating Strut (Ref.)	S84-SD33-11
37	1	Shut-Off Valve	S84-33-598
38		Magnetic Shut-Off Valve (Ref.)	S84-SD33-44
39	1	Shut-Off Valve	S84-33-598
40		Elevating Motor (Ref.)	S84-SD33-26
41		Seat Actuating Strut (Ref.)	S84-SD33-10
42		Training Motor (Ref.)	S84-SD33-26
43	1	Main Control Valve	Vickers AA13601
44	1	Overpower Valve	S84-39-581
45		Overpower Cylinder (Ref.)	S84-SD33-36

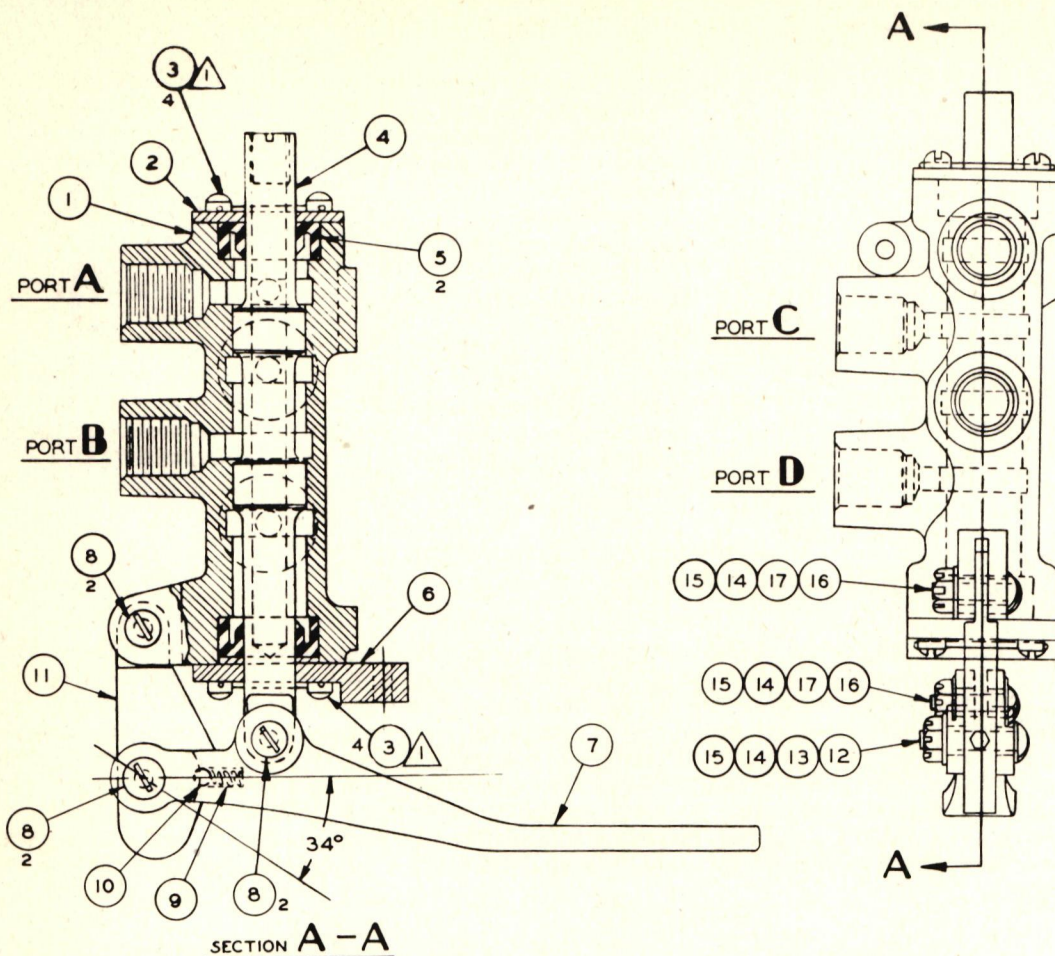
The rotation of the turret and aiming of the gun is accomplished hydraulically by means of two Vickers hydraulic motors and a Vickers turret control valve. A short stick, similar to a pilot's control stick, is located on top of the control valve and may be moved universally to impart the desired movements to the turret and gun. Sidewise movement of the stick produces rotation of the turret to move the gun muzzle in a corresponding direction. Fore and aft movement of the stick, respectively depresses or elevates the gun muzzle, by moving the gun about the horizontal axis of the mount. When the control stick is in "NEUTRAL," both the turret and gun are fixed in whatever position they have attained when the stick is neutralized. The speed of movement of both the turret and gun is proportional to the amount the stick is displaced from "NEUTRAL."

CAUTION: Be sure the mechanical turret ring lock is released before operating the turret control valve.

The turret control stick incorporates two electrical switches, the one on the forward side being the gun trigger switch, the one at the top a safety switch (sometimes known as a "dead man's switch"). The turret and gun will not move regardless of the position of the stick, unless the safety button is depressed. This "locking" is accomplished by means of a magnetic valve, known as the turret lock valve, which is installed in the return lines from the Vickers motor and the turret control valve. This magnetic valve is controlled by the safety switch.

The circuit of the magnetic valve also includes two micro-switches in parallel for limiting the elevation of the gun to 85 degrees. The other switch is installed forward of the control stick and is normally open. Therefore, if the stick is held back until the gun attains an elevation of 85 degrees, the magnetic valve circuit is opened by the gun micro-switch, and the gun stops moving, due to blocking of the hydraulic system. However, the system can be immediately unlocked by moving the stick forward to close the other micro-switch. This action automatically starts the gun down from the 85 degrees elevation and, as soon as it leaves the micro-switch, the switch closes to restore the circuit to its normal arrangement.

Referring to fig. 30-IX, note that a branch from the return line between the turret control valve and the turret lock valve connects to the high pressure supply line through a check valve. The function of this check valve is to relieve pressure above supply pressure which may build up in the return line, due to sudden closing of the magnetic valve and to the inertia of the moving turret or gun. By relieving into the high pressure line rather than into the return line beyond the turret lock valve, the Vickers motors and the turret control valve are under more or less constant hydraulic pressure, which insures positive control and smooth action.



(C. W. Assembly No. S84-33-611)
Figure 31-IX - Turtleback Control Valve

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Body	S84-33-615
2	1	End Cap	S84-33-650
3	8	Screw	AN502-10-8
4	1	Plunger Assembly	S84-33-513
5	2	Packing	1145-D-531
6	1	Head	S84-33-612
7	1	Handle Assembly	S84-33-616
8	6	Press Bushing	1002-D-3-.156
9	1	Spring	S84-33-671
10	1	Commercial Steel Ball 3/16-Dia.	S84-33-616-1
11	1	Link	S84-33-614
12	1	Bolt	AN23-17
13	1	Washer	AN960-10L
14	3	Nut	AN320-3
15	3	Cotter Pin	AN380-C2-2
16	2	Bolt	AN23-14
17	2	Washer	AN960-10

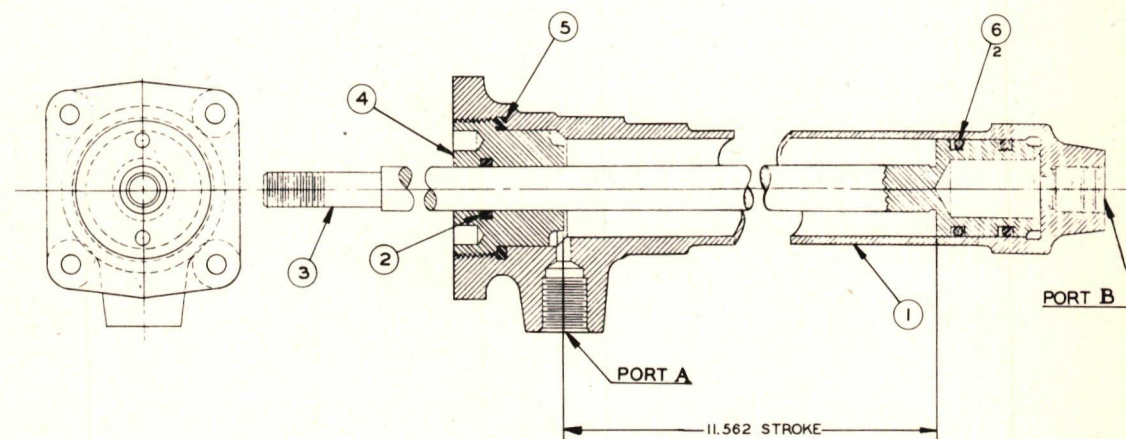
NOTES:

- ① Lock wires required as shown.

PRESSURE TEST:

1. Use Specification No. AN-VV-O-366a hydraulic fluid.
2. Plug ports "C," "D" and "B." Apply 1500 pounds per square inch pressure for five minutes at port "A" with plunger in position shown. No external leakage should occur.
3. Plug port "C." Apply 1500 pounds per square inch pressure for five minutes at port "B" with plunger in position shown. Leakage at ports "A" and "D" should not exceed five drops per minute.

S84-SD33-02



Ref. No.	Quantity	Item	Part No.
1	1	Cylinder	S84-33-841
2	1	Packing	AN6227-11
3	1	Piston	S84-33-705
4	1	Cap	S84-33-706
5	1	Packing	AN6227-27
6	2	Packing	AN6227-19

NOTES:

1. Bursting test - Apply 2500 pounds per square inch pressure to ports "A" and "B" simultaneously. Test to be applied to one strut.
2. Apply 1500 pounds per square inch pressure to port "A." Leakage past the piston shall not exceed five drops per minute. There shall be no external leakage.
3. Apply 1500 pounds per square inch pressure to port "B." Leakage past the piston shall not exceed five drops per minute. There shall be no external leakage.

(C. W. Assembly No. S84-33-704)

Figure 32-IX - Turtleback Retracting Strut

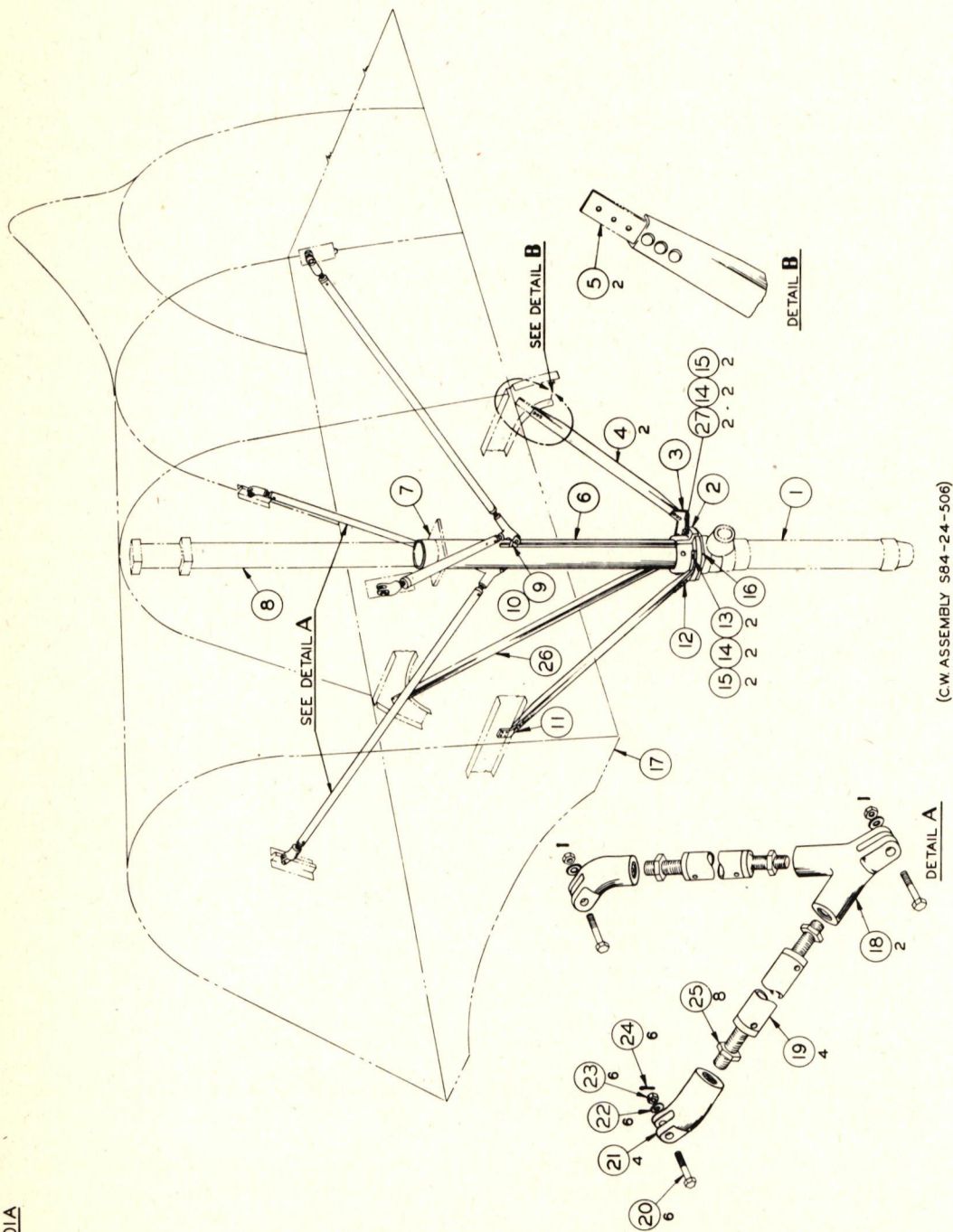


Figure 33-IX - Turtleback Actuating Mechanism

PARTS LIST - TURTLEBACK ACTUATING MECHANISM

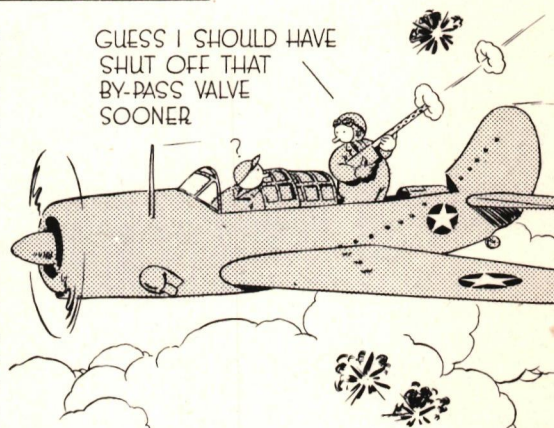
<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Retracting Strut Assembly (Ref.)	S84-SD33-02
2	1	Support Segment	S84-24-510-1
3	1	Fitting	S84-24-515
4	2	Brace	S84-24-513
5	2	Fitting	S84-24-516
6	1	Tube Guide	S84-24-507
7	1	Double Plate (Ref.)	S84-24-512
8	1	Support Assembly (Ref.)	S84-24-524
9	1	Nut	S84-24-511
10	1	Block	S84-24-519
11	1	Fitting (Ref.)	S84-24-514
12	1	Angle	S84-24-517
13	2	Bolt	AN4-10A
14	4	Washer	AN960-A416
15	4	Nut	AN365-428
16	1	Support Segment	S84-24-510-2
17	1	Turtleback Assembly (Ref.)	S84-24-501
18	2	Terminal Assembly	S84-24-508
19	4	Weld Assembly	S84-24-518
20	6	Bolt	AN3-10
21	4	Terminal Assembly	S84-24-509
22	6	Washer	AN960-D10
23	6	Nut	AN310-3
24	6	Cotter Pin	AN380-C2-3
25	8	Nut	AN316-C4R
26	1	Channel	S84-24-528
27	2	Bolt	AN4-7A

A manually-operated bypass valve (39) is installed to permit operation of the turret and gun in case of failure or malfunctioning of the magnetic valve. The bypass valve, however, should be opened only in emergency, because the micro-switches will not stop the gun at 85 degrees elevation when the bypass valve is open.

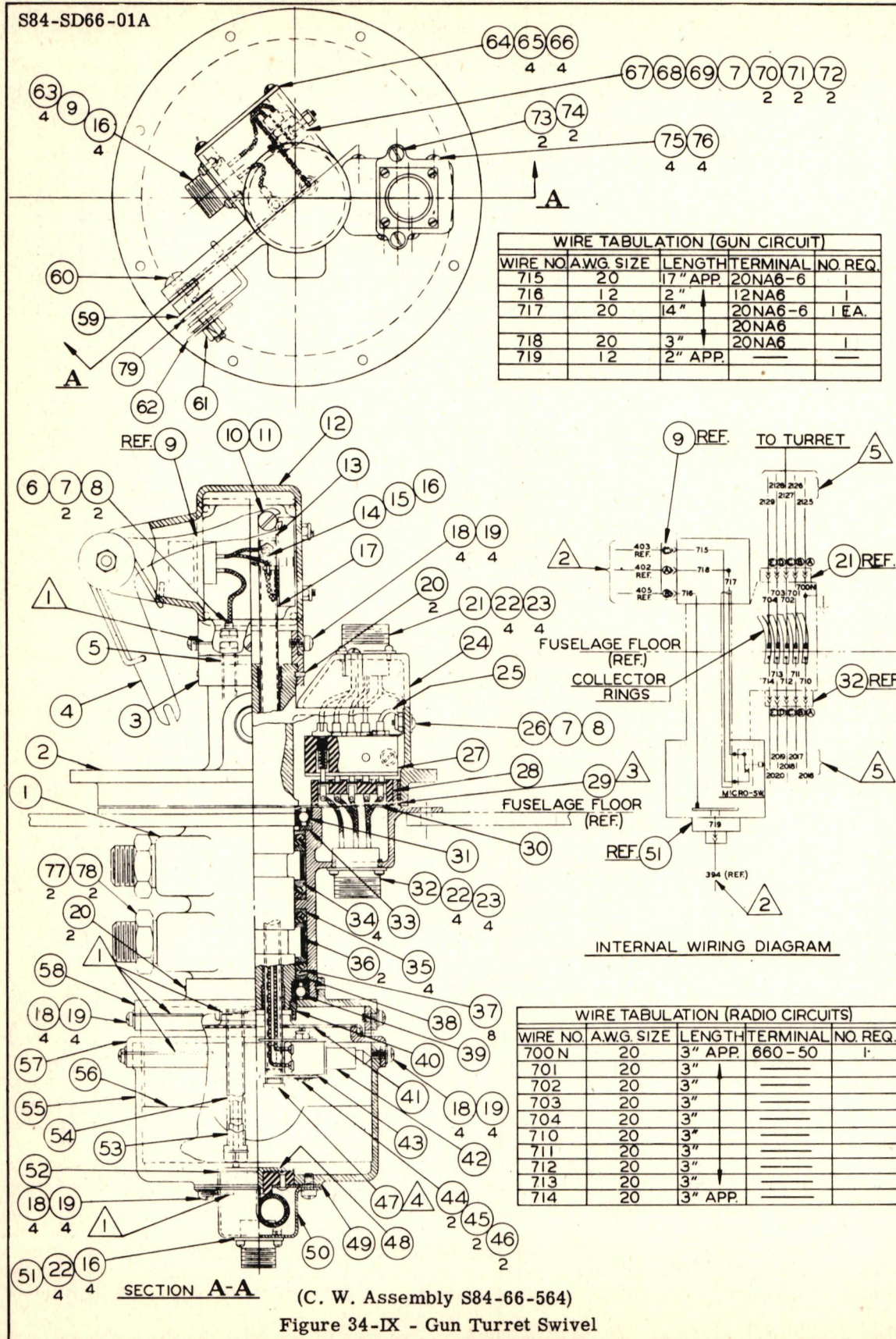
A combination mechanical and hydraulic arrangement is provided to prevent the gun from coming into contact with the airplane during operation of the gun turret. The control portion of the mechanism consists of linkage attached to the gun mount, and a cam follower which rides on a profile cam attached to the fixed turret ring. In addition, the linkage is

attached to the plunger of an overpower valve (44). The overpower valve, in turn, controls fluid pressure to the overpower cylinder (45), which is installed in front of the turret control stick. If, at any time, the gun is in a depressed position when rotation of the turret could swing it into the airplane structure, the linkage will be displaced when the turret rotates the gun nearer than a safe clearance. The resulting displacement of the plunger of the Vickers overpower valve allows hydraulic pressure to operate the overpower cylinder (45). The extending plunger of the overpower cylinder forces a centering cam against the turret control stick, overpowering the gunner's control, and moves the stick back to elevate the gun before allowing further rotation of the turret. The arrangement is such that, if the control stick is held forward and to either right or left (with safety button depressed), the gun muzzle will follow a predetermined clearance line with respect to the fuselage.

The gunner's seat assembly rides on two vertical tracks, and is elevated or depressed in unison with the breech of the gun by means of a closed hydraulic circuit containing two struts. The operating strut is attached to the gun elevating mechanism, while the operated strut is at-



S84-SD66-01A



PARTS LIST - GUN TURRET SWIVEL

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Base	S84-33-722
2	1	Swivel Assembly	S84-33-721
3	1	Adaptor-Cap (Upper)	S84-33-225
4	1	Bell Crank	S84-66-864
5	1	Spacer Tube (Upper)	S84-66-141
6	1	Terminal Assembly	S84-66-633
7	4	Nut	AC365-B1032
8	3	Washer	AN960-B10
9	1	Receptacle	AN3102-18-5S
10	1	Clevis Bolt	AN23-10A
11	1	Nut	AC365-1032
12	1	Housing Bell Crank	S84-66-614
13	1	End Profile Rod	S84-66-127
14	1	Taper Pin	663-D-00-4
15	1	Washer	664-D-4
16	9	Nut	AC365-440
17	1	Profile Rod	S84-66-128
18	16	Screw	AN502-10-4
19	16	Washer	AN960-10L
20	4	Cup Point Set Screw	Allen #10-32 x .25 NF3
21	1	Receptacle	AN3102-16S-1S
22	12	Screw	AN515-4-5
23	8	Washer	AN936-B4
24	1	Cover Receptacle	S84-66-619
25		Brush Pigtail Ground Connection (Ref.)	
26	1	Screw	AN520-B10-7
27	1	Housing Brush Assembly	S84-66-631
28	1	Holder Assembly	S84-66-628
29		Felt Seal	S84-66-564-2
30	1	Washer Insulator	S84-66-090
31	1	Bearing	Fafnir-K-29B
32	1	Receptacle	AN3102-16S-1P
33	1	Ring (Upper)	S84-33-223
34	4	Adaptor	S84-33-229-2
35	4	Adaptor	S84-33-229-1
36	2	Spacer	S84-33-230
37	8	Packing	S84-33-728
38	1	Ring (Lower)	S84-33-224
39	1	Bearing	Fafnir-K-25B
40	1	Nut	S84-33-727
41	1	Shield	S84-66-621
42	1	Micro-Switch	WZ-2RQTC1
43	1	Insulator Switch	S84-66-130
44	2	Screw	AN526-632-18
45	2	Nut	AC365-632
46	2	Washer	AN960-6
47	1	Plug Insulator	S84-66-131
48	1	Contact	S84-66-635
49	1	Contact Assembly	S84-66-626
50	1	Cap (Lower)	S84-66-618
51	1	Receptacle	AN3102-12-5P
52	1	Washer Insulator	S84-66-133
53	1	Spacer Tube (Lower)	S84-66-138
54	1	Tube Insulator	S84-66-101
55	1	Housing Assembly	S84-66-616-950
56	1	Tube Profile	S84-66-620-1
57	1	Cap-Oil Seal	S84-66-617
58	1	Cap Adaptor	S84-66-615
59	1	Spring	S84-58-597

PARTS LIST - GUN TURRET SWIVEL

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
60	1	Clevis Bolt	AN24-26A
61	1	Nut	NAF1137-428
62	1	Washer	1075-00-064-.265-1.250
63	4	Screw	AN515-4-7
64	1	Cover	S84-66-622
65	4	Screw	AN515-8-6
66	4	Washer	NAF-1058-B8E
67	1	Lettered Block	S84-66-629-3
68	1	Insulator	S82-66-402-1
69	1	Terminal Screw	S82-66-382-12
70	2	Screw	AN515-8-10
71	2	Washer	AN960-8
72	2	Nut	AC365-832
73	2	Screw	AN515-8-24
74	2	Lock Washer	AN936-B8
75	4	Screw	AN515-6-7
76	4	Lock Washer	AN936-B6
77	2	Gasket	AN902-10
78	2	Union	AN902-10D
79	1	Rod	S84-58-598

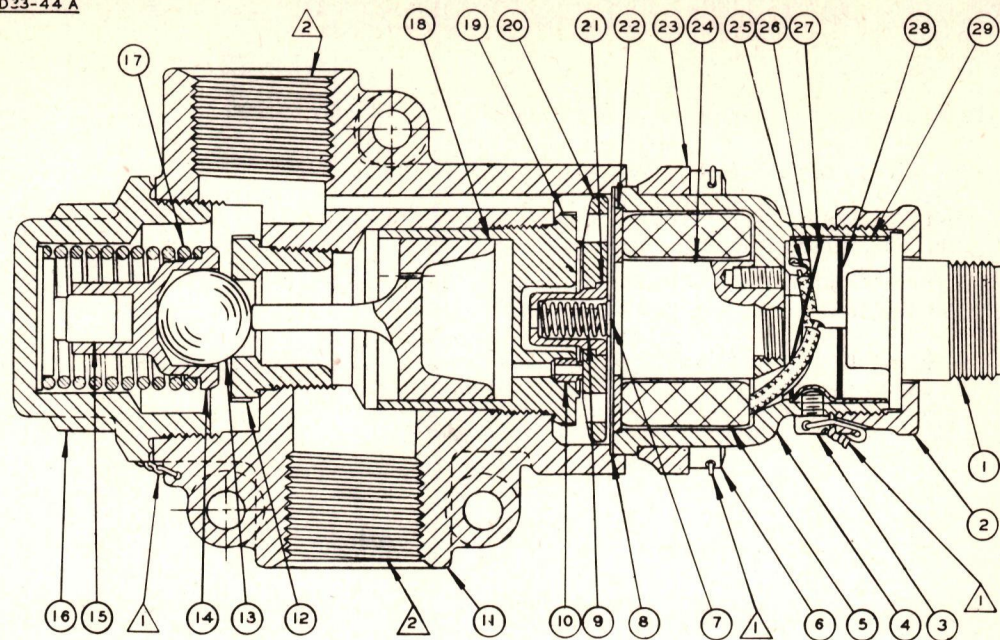
NOTES:

- ① Lock wire required as shown.
- ② Reference drawing S84-66-505 electrical wiring diagram.
- ③ Cement felt seal to S84-33-722.
- ④ Press into tube.
- ⑤ Reference drawing S84-67-503 - radio wiring diagram.
6. Thomas and Betts solderless terminals.
7. All wire Specification No. M-393.

tached to the seat mechanism. The mechanical arrangement of the operating strut is such, that the piston is extended by elevation of the gun, which obviously results in a corresponding retraction of the piston of the operated strut (and vice versa). The seat thus moves up or down the proper amount to allow the gunner to follow the target through the sight.

A relief valve (35) is installed to permit relief of the main pressure line into the return line, to relieve any excess pressure that may be developed in the system as a result of the various operations, particularly operation of the seat struts. The valve relieves at approximately 2000 pounds per square inch pressure. A check valve is installed in the high pressure supply line ahead of the seat strut circuit to prevent pressure surges, due to seat strut operation, from reaching other units of the turret hydraulic system.

It should be noted that the magnetic valve (item 38, of fig. 30-IX) controls only that portion of the system involved in rotation of the turret and movement of the gun. The remaining portions of the system, including the gun charger valve, are connected to the high pressure supply at all times during normal operation. However, manually-operated valves (items 8 and 30, fig. 1-IX) allow the pilot or gunner, respectively, to shut off pressure to the entire turret hydraulic system. Closing valve (8) also shuts off pressure to the remainder of the armament equipment.



Ref. No.	Quantity	Item	Part No.
1	1	Cable Connector	AN3102-10S-2P
2	1	Connector Union Nut	4913A
3	1	Safety Wire Retaining Screw	4942
4		Coil Housing	4229K *
5		Coil	10472A-32 *
6	4	Solenoid Flange Screw	4877.87
7	1	Spring Guide	4938A
8	1	Diaphragm	4233
9	1	Armature Spring	4870
10		Port Inserts	4839C **
11		Valve Body	5000B **
12	1	Valve Seat	5011
13		Valve Ball	3135A.5 ***
14		Ball Retainer	5012 ***
15	1	Spring Seat	5016
16	1	Bottom Cap	5014
17	1	Valve Spring	5013
18	1	Valve Piston	5010
19		Valve Cylinder	5009 **
20	1	Armature	4236B
21	1	Spring Retaining Cup	4937
22		Diaphragm Support Plate	4864 *
23	1	Solenoid Flange	4234B
24		Solenoid Core	4230G *
25		Core Lock Screw Retainer	4863 *
26		Core Lock Screw	4226B *
27	1	Insulation Washer	4944A
28	1	Insulation Washer	4944B
29	1	Wall Insulation	5132A

(THIS DWG. CONFORMS TO GENERAL CONTROLS CO. DWG. 40R268)

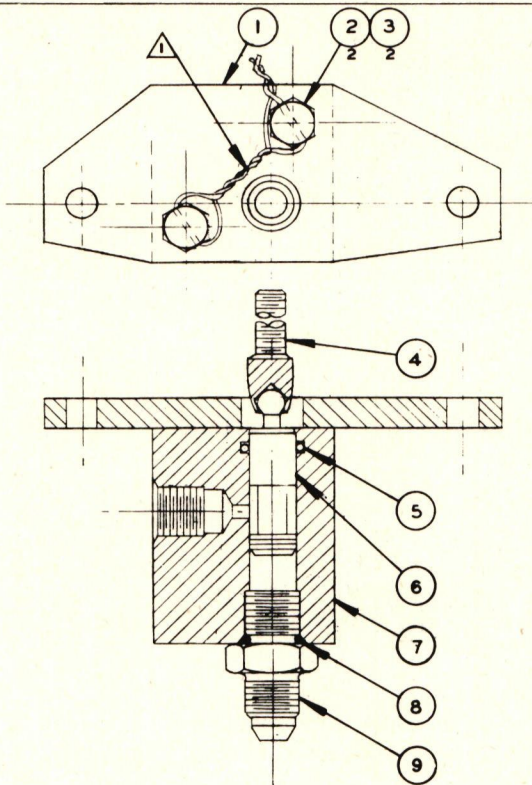
Figure 35-IX - Turret Magnetic Shut-Off Valve

PARTS LIST - TURRET MAGNETIC SHUT-OFF VALVE

NOTES:

- ① Use lock wire as required.
- ② 3/4-16NF-3 pipe thread Specification No. AND10050.
3. Parts marked thus * are parts of Solenoid Assembly No. 10486B.32, and cannot be purchased separately.
4. Parts marked thus ** are parts of valve body and cylinder assembly No. 10522, and cannot be purchased separately.
5. Parts marked thus *** are parts of valve ball assembly No. 10546A and cannot be purchased separately.

S84-SD33-52

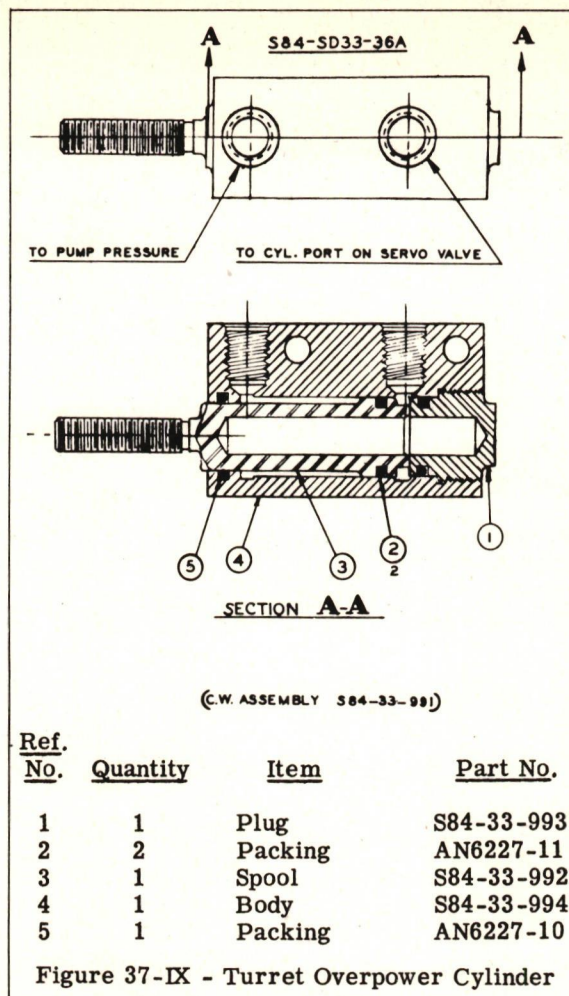


<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Plate	S84-59-935
2	2	Bolt	AN73-4
3	2	Washer	AN960-10
4	1	Plunger	S84-691-1010 *
5	1	Packing	AN6227-7
6	1	Spool	S84-691-1012 *
7	1	Body	S84-39-582
8	1	Gasket	AN902-4
9	1	Fitting	AN920-4D

NOTES:

- ① Lock wire as required, lock wire AN-QQ-W-435.
- * These items make up piston assembly S84-691-1011.

Figure 36-IX - Turret Overpower Valve



(2) Parts. - Detail section drawings of the following units of the turret hydraulic systems are included herein:

Figure 34 - Gun Turret Swivel

- 16 - Hydraulic Motor
- 39 - Seat Actuating Strut
- 38 - Seat Elevating Strut
- 37 - Overpower Cylinder

(a) Swivel. - Note that the swivel contains both hydraulic passages and electric wiring. A schematic of the wiring is shown on the drawing. Access to the electrical portion for service may be easily accomplished by reference to the drawing and the actual unit. Replacement of hydraulic packing is normally an overhaul operation requiring practically complete disassembly of the unit.

(b) Seat Struts. - Disassembly of the seat struts should be easily understood by reference to the figs. 38-IX and 39-IX.

Before installing new seals, clean parts thoroughly and allow to dry. Lubricate all seals thoroughly with hydraulic fluid, Specification No. AN-VV-O-366a, before installing.

CAUTION: Before operating the gun elevating mechanism following any disturbance of the seat

strut hydraulic circuit, such as opening of synchronizing valve (item 37, fig. 30-IX) or disconnection of the interconnecting lines, synchronize the seat struts as follows:

Depress the seat if necessary to latch it in one of the three "gunning" positions.

If the synchronizing valve is open, close it. In all cases check to see that it is closed.

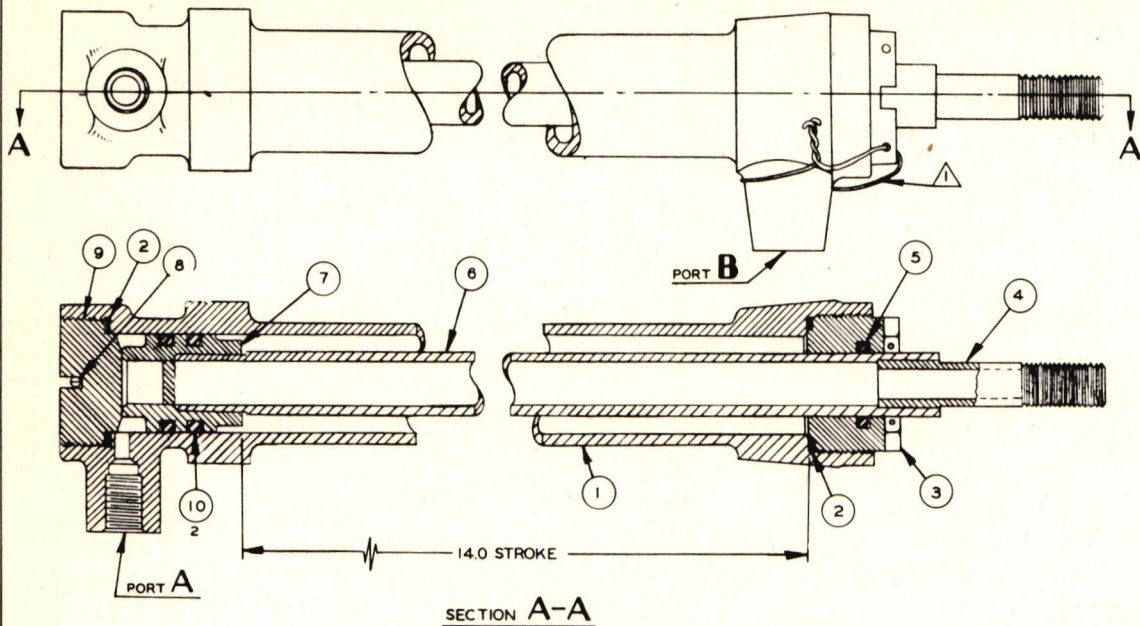
Admit hydraulic pressure from the main system to the turret by opening shut-off valve, items 8 or 30 or both, fig. 30-IX.

Slowly and carefully open ("crack") the synchronizing valve (item 37, fig. 30-IX) to admit fluid under pressure to the line interconnecting the seat struts. Since this pressure acts against the entire piston area, the piston of the seat elevating strut will extend to its full "UP" position and remain there. Open the synchronizing valve fully and leave it open; then operate the turret control stick in the normal manner to depress the gun muzzle to 70 degrees below the horizon (full "DOWN" position).

With the gun muzzle fully depressed and the seat elevating strut fully extended "UP," close the synchronizing valve tightly and safety with lock wire. This valve should never be tampered with or opened during normal operation of the turret; its sole function is to lock the fluid in the interconnecting line of the seat struts.

9. Charging Accumulator.

The correct preload air pressure for the accumulator is 450 pounds per square inch. The



<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Cylinder	S84-33-678
2	2	Packing	AN6227-23
3	1	Cap	S84-33-675
4	1	Adaptor	S84-33-666
5	1	Packing	AN6227-15
6	1	Piston Rod	S84-33-672
7	1	Piston Head	S84-33-665
8	1	Cotter Pin	AN380C3-8
9	1	End	S84-33-681
10	2	Packing	AN6227-17

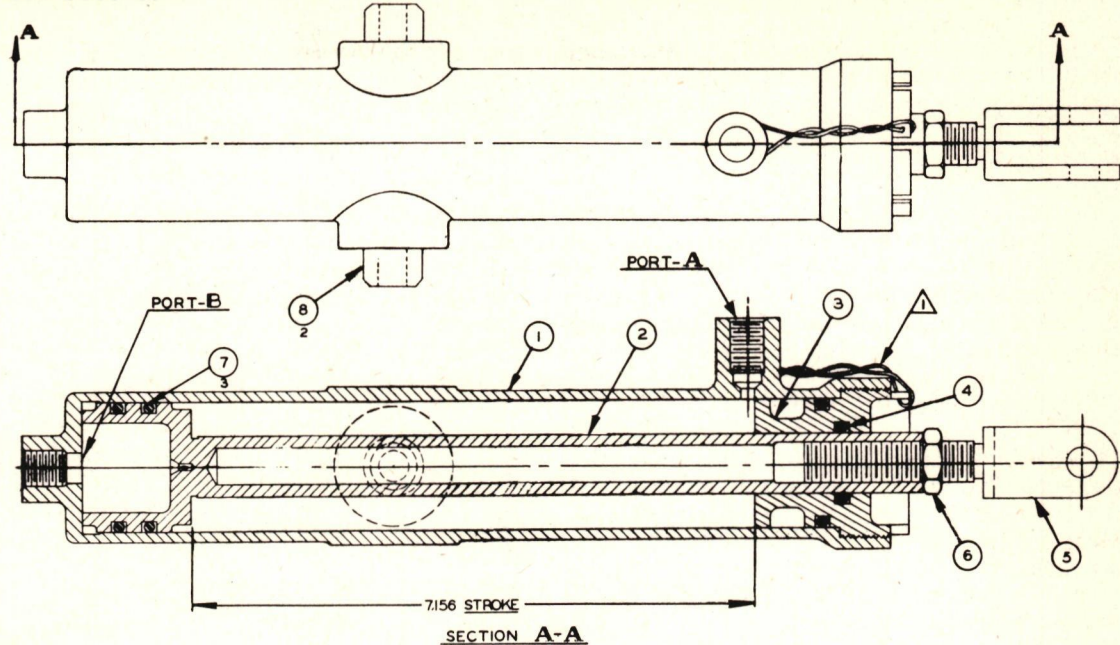
NOTES:

1. Lock wire required as shown.
2. Bursting test: Apply 2500 pounds per square inch to ports "A" and "B" simultaneously.
3. Apply 1500 pounds per square inch pressure to port "A." The leakage past the piston shall not exceed five drops per minute. There shall be no external leakage.
4. Apply 1500 pounds per square inch pressure to port "B." The leakage past the piston shall not exceed five drops per minute. There shall be no external leakage.
5. For additional testing information, see Specification No. S-345.
6. Assemble fittings per Specification No. AN-H-2, page 12.

(C. W. Assembly S84-33-676)

Figure 38-IX - Turret Seat Elevating Strut

S84-SD33-10



Ref. No.	Quantity	Item	Part No.
1	1	Cylinder Assembly	S84-33-685
2	1	Piston	S84-33-619
3	1	Cap	S84-33-820
4	1	Packing	AN6227-15
5	1	Eye Bolt	S84-33-188
6	1	Nut	AN316-8R
7	3	Packing	AN6227-25
8	2	Trunnion Pin (Ref.)	S84-69-667

NOTES:

- △ Lock wire required as shown.

PRESSURE TEST:

1. Bursting test: Apply 2500 pounds per square inch to ports "A" and "B" simultaneously.
2. Apply 1500 pounds per square inch pressure to port "A." Leakage past piston shall not exceed five drops per minute.
3. Apply 1500 pounds per square inch to port "B." Leakage past piston shall not exceed five drops per minute. There shall be no external leakage.
4. For additional testing information, see Curtiss Specification S-345.
5. Strut must be free from dirt and chips.
6. Assemble fittings per Specification AN-H-2, page 12.

C-W Assembly No. S84-33-824

Figure 39-IX - Turret Seat Actuating Strut

accumulator air pressure is indicated by the right-hand gage on the floor, which shows preload air pressure only when the hydraulic pressure, as indicated by the gage on the panel, is "ZERO" or less than the air pressure gage reading.

A standard air valve is provided at the bottom of the accumulator. If the preload air pressure is low, connect a suitable compressed air source to the air valve and charge the accumulator to 450 pounds per square inch with hydraulic pressure at zero.

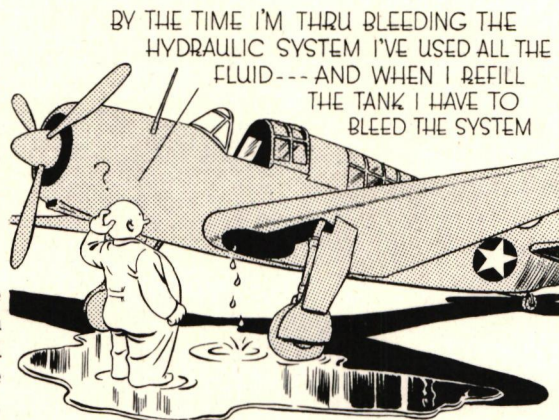
10. Filling Hydraulic Reservoir.

The fluid level in the hydraulic reservoir will be checked daily. When checking fluid level or adding fluid, the airplane shall be in normal three-point position with the landing gear and tail wheel locked down, all other hydraulically-operated items in normal flight condition, and accumulator hydraulic pressure "ZERO." If required, add fluid as specified to level of filler opening. Keep containers and fluid scrupulously clean and do not allow any dirt to enter the reservoir. Replace cap after servicing reservoir. Service with fluid, Specification No. AN-VV-O-366a.

11. Bleeding Hydraulic System.

a. General.- The A-25A hydraulic system is quite extensive, but is largely self-bleeding under normal operating conditions. However, following system drainage or extensive service operations, it is advisable to bleed the system as outlined herein to insure elimination of entrapped air.

b. Bleeding after Initial Filling.- Support the airplane with jacks or hoist, as specified in section VII. See that the landing gear and tail wheel are clear of the ground. Check to see that all drains and bypass valves are closed, that accumulator has been charged to correct preload air pressure, and that reservoir has been filled with fluid as specified on fig. 5-IX.



Referring to fig. 5-IX, operate all motor-driven hydraulic mechanism through one or more complete cycles by means of the hand pump.

Methodically loosen ("crack") the hydraulic connections to each port of all hydraulic struts, one at a time, and operate the hydraulic hand pump until fluid free of air flows from the line. Tighten each connection while still pumping fluid through to prevent air from entering. After all strut lines have been bled, operate the strut mechanisms through two or more complete cycles to eliminate any residual air present. During this operation, check for any "sponginess" in the action of the various struts and, if present, loosen the line connections at the strut and rebleed as above.

Remove bleeder screw from bleeder plug at top of brake housing, and install standard bleeder hose. Loosen bleeder plug, depress brake pedal, and operate hand pump until fluid free of air flows from hose; then tighten bleeder plug, and remove hose. Re-install screw in bleeder plug. Keep end of bleeder hose below surface of discharged fluid (customary bleeding procedure). Bleed both brakes.

Loosen ("crack") the accumulator supply line connection at the unloading valve (item 3, fig. 1-IX), open the shut-off valve (item 6), and operate the hand pump until fluid free of air flows from the line. Tighten the connection while still pumping fluid through the line.

After tightening fittings, operate the hand pump until accumulator hydraulic pressure is above 900 pounds per square inch; then close the shut-off valve (item 6, fig. 1-IX). Start the engine in the normal manner. A short period of operation should bleed the engine pump lines and unloading valve. The object in previously building up accumulator pressure above 900 pounds per square inch with the hand pump is to insure that the initial operation of the engine pump will circulate fluid and entrapped air through the unloading valve to the reservoir and not into the accumulator supply line.

Section X

INSTRUMENTS AND VACUUM SYSTEM

1. Maintenance and Repair.

Maintenance and repair of aircraft instruments is based on the facilities which are available to the various agencies doing the work. They may be divided as follows:

a. Major Repairs.- This class of work is performed at depots only.

b. Base Repairs.- This consists of bench tests and related minor repairs made by specially trained personnel who may be attached to base squadrons or detachments.

c. Line Maintenance.- This work is performed by the crew chief and his assistants. It consists, normally, of the following:

(1) Daily Inspection of:

(a) Pointers for excessive error at zero, except thermometers and absolute pressure-operated instruments, which should show indications consistent with surrounding temperature and pressure conditions.

(b) Instruments for loose or cracked cover glass.

(c) Caging and setting knobs for freedom of movement and correct operation.

(2) Preflight Inspection.- Performed previous to the first flight of the day, it consists in checking:

(a) Instrument pointers for excessive oscillation.

(b) Readings for consistency with engine requirements and speeds.

(3) Fifty-Hour Inspection, consisting of:

(a) Instruments and dependent units for security of mounting.

(b) Lines and connections for leaks.

(c) Dial markings and pointers for dull and discolored luminous paint.

(d) Operation markings for correctness and discernability.

(e) Electrical and bonding connections for good contacts and security of attachment.

(f) Vibration absorbers for security of attachment and proper tension.

(4) Removal and Replacement.- Instruments are replaced for any of the following reasons:

(a) Failure to indicate.

(b) Inaccurate indication.

(c) Leak in case.

(d) Loose pointer.

- (e) Loose or cracked cover glass.
- (f) Broken or cracked mounting lug.
- (g) Defective setting or caging mechanism.
- (h) Defective binding posts or connecting nipples.
- (i) Dull or discolored luminous markings.
- (j) Any known or suspected defects in internal mechanisms.

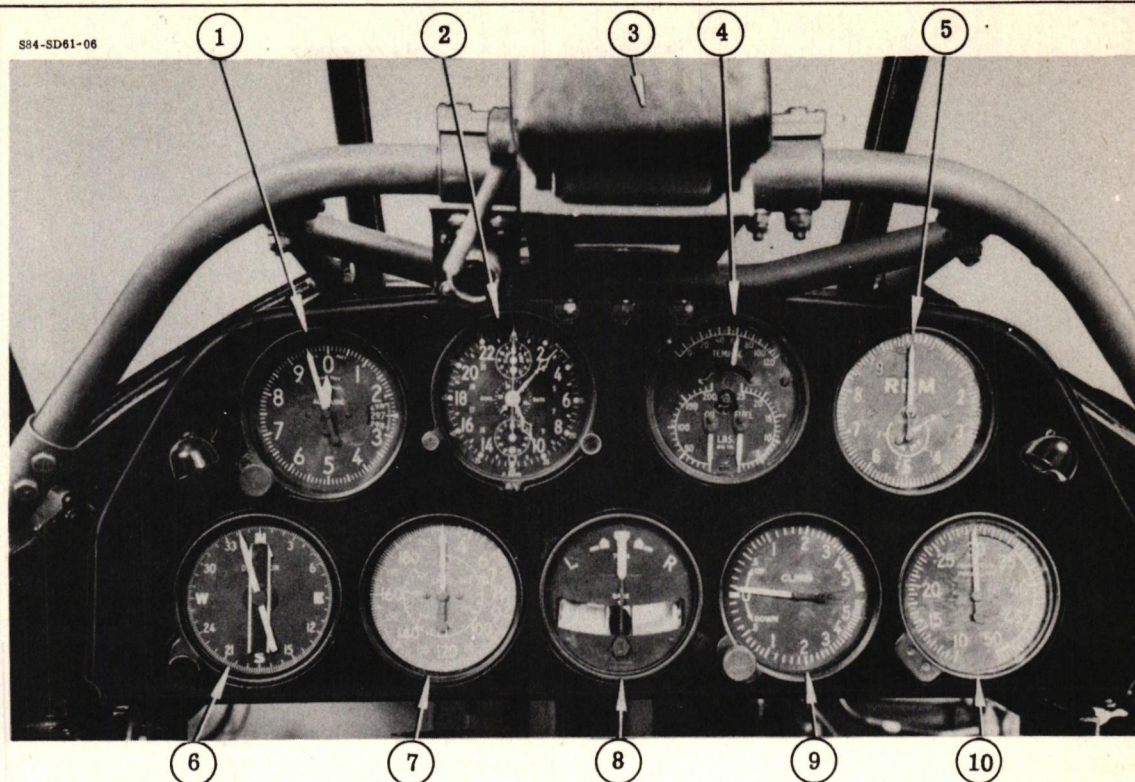
(5) Some Considerations to be Remembered When Replacing Instruments are.-

- (a) They should be handled very carefully.
- (b) Unless specifically authorized to the contrary, instruments are always replaced with those of like kind and type.
- (c) The location of an instrument or any of its dependent units is not to be changed without proper authority.
- (d) When checking instruments, take care not to subject it to undue or abnormal pressures.
- (e) If too much force is applied when inserting the mounting screws into the self-locking lug inserts, there is danger of pushing the inserts from the case.
- (f) When making connections to the instruments, use small tools and take care not to twist or strain the fittings.
- (g) Instrument thread compound (Army Specification No. 2-87) is used on all threaded connections.

2. The Following Instruments and Dependent Units are Found in the A-25A Airplane,

a. Upper Instrument Panel (Refer to fig. 1-X).-

Ref. No.	Item	Part No.	Airplane No.
1.	Altimeter, Pioneer No. 1537-2F-B	88-A-340	41-18774 to 42-81252
	Altimeter Assembly, Type C-11	AN-5760-3	42-81253 and up
2.	Clock Assembly, 7-jewel, Type A-11	94-27970	41-18785 and up
4.	Engine Gage Unit, Thomas Edison, No. P109-B103	88-U-310	41-18774 to 42-79972
	Engine Gage Unit, Thermometer Bulb	88-B-900	
	Engine Gage Unit, Type BB Engine Gage Unit, Tachometer	27423 AN5525-1	42-79973 and up 42-79973 and up
5.	Electric Tachometer Indicator G.E. Part No. 8DJ13AA7-22	88-1-2500	41-18774 to 42-80132
	Tachometer Generator	88-G-1380	41-18774 to 42-80132
	Tachometer Indicator Tachometer Generator, Type E-13	94-27354 94-27354	42-80133 and up 42-80133 and up
6.	Indicator, Remote Indicating Compass, Pioneer No. 1006-1AA1	AN5730-2	41-18774 and up
	Transmitter, Remote Indication Compass	AN-5730-3	41-18774 and up
	Inverter, Remote Indicating Compass	94-32270	41-18874 and up

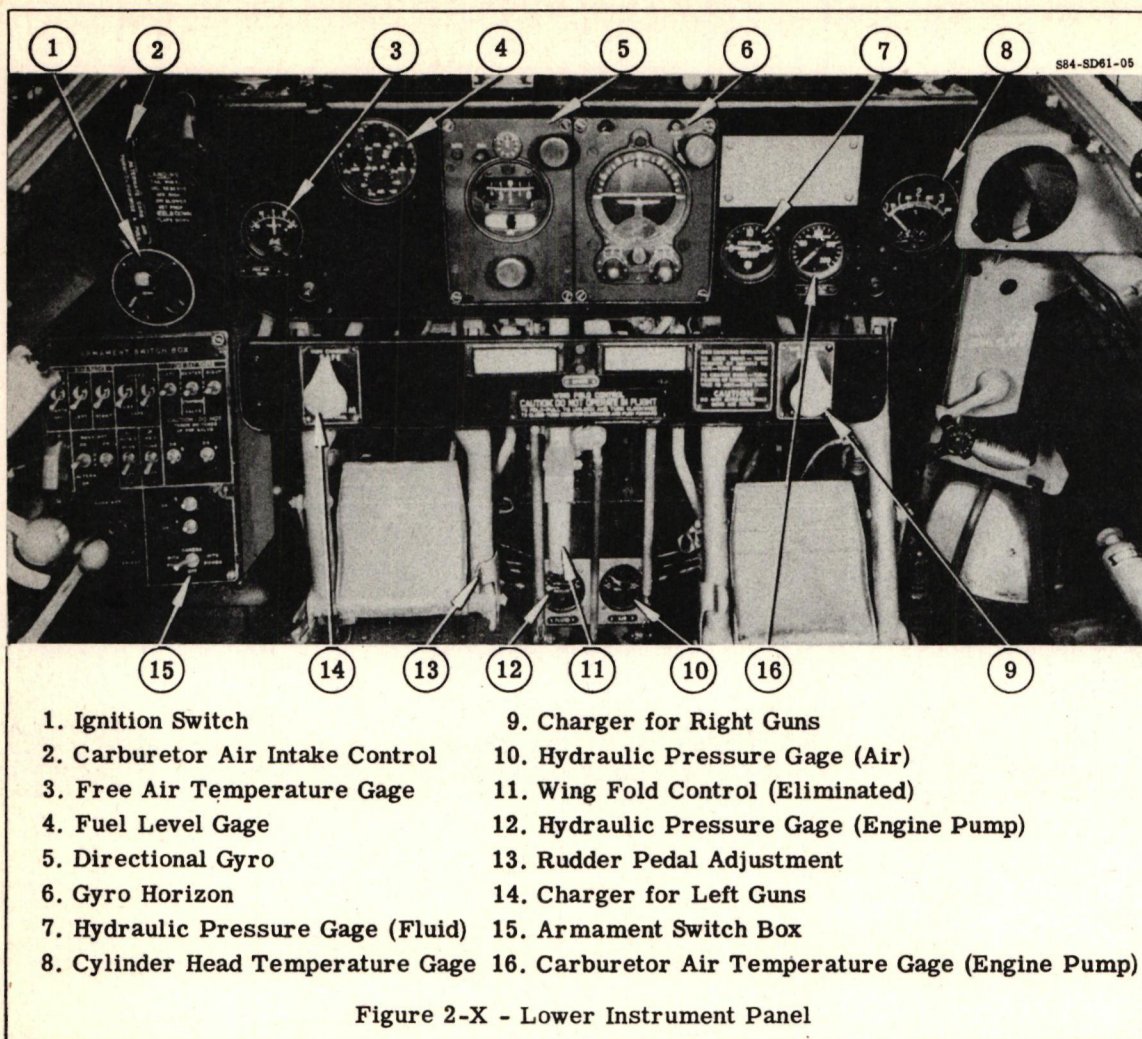


- | | |
|---------------------|----------------------------|
| 1. Altimeter | 6. Compass |
| 2. Clock | 7. Air Speed Indicator |
| 3. Crash Pad | 8. Turn and Bank Indicator |
| 4. Engine Gage Unit | 9. Climb Indicator |
| 5. Tachometer | 10. Manifold Pressure Gage |

Figure 1-X - Upper Instrument Panel

Ref. No.	Item	Part No.	Airplane No.
	Compass Deviation Card	88-C-200	41-18774 to 42-80292
	Holder, Compass Deviation Card	88-H-500	41-18774 to 42-80292
	Pilot's Compass Correction Card	AAF-57	42-80293 and up
	Compass, Correction Card Holder	AN-5800-4	42-80293 and up

Ref. No.	Item	Part No.	Airplane No.
7.	Airspeed Indicator, Type F-2	27335	41-18774 and up
	Pitot Static Tube	88-T-3000	41-18744 to 42-79732
	Electrically-heated Airspeed Tube, Type D-1	AN-5816-2	42-79733 and up
8.	Bank and Turn Indicator Pioneer No. 1719-1AF-A1	88-1-3280	41-18774 to 42-80292
	Bank and Turn Indicator, Type A-11	AN-5820-1	42-80292 and up
9.	Climb Indicator Pioneer No. 1640-6E-A1	88-1-750	41-18774 to 42-79972
	Rate of Climb, Type C-2	AN5825-2	42-79972 and up
10.	Manifold Pressure Gage Pioneer No. 1925-1M-A1	88-G-700	41-18774 to 42-80772
	Manifold Pressure Gage Single Type, D-10	AN-5770-1	42-80773 and up



b. Lower Instrument Panel (Refer to fig. 2-X).-

Ref. No.	Item	Part No.	Airplane No.
3.	Free Air Indicator Weston Electric Part No. 102017 Free Air Temperature Bulb	88-1-2865 88-B-900	41-18774 to 42-79972 41-18774 to 42-79972
	Free Air Temperature Indicator Free Air Temperature Bulb	AN-5790-6 AN-5525-1	42-79973 and up 42-79973 and up
4.	Fuel Gage Indicator, No. 468188 G. E. Type J-4, Model 8DJ4PCS Fuel Level Transmitter G. E. Type 8TJ13LDK41 (Wing) G. E. Type 8TJ13LEY41 (Fuselage)		41-18774 and up 41-18774 and up
5.	Directional Gyro	AN-5735-2	41-18774 and up
6.	Gyro Horizon Carburetor Air Indicator Carburetor Air Resistance Bulb	AN-5736-2 AN-5790-6 AN-5525-1	41-18774 and up 41-18824 and up 41-18824 and up
7.	Hydraulic System Pressure Gage	S84-61-598	41-18774 and up
8.	Thermocouple, Single Point, including: Connector	88-C-1300	41-18774 to 42-79973

Ref. No.	Item	Part No.	Airplane No.
	Lead, Engine Disconnect type	88-L-650	41-18774 to 42-79973
	Thermocouple, Gasket-type	88-T-1060	41-18774 to 42-79973
	Indicator, Engine Cylinder Temperature, (W. E. Corp. No. 103068)	88-I-2650	41-18774 to 42-79973
	Lead, Indicator Disconnect-Type	88-L-800-10	41-18774 to 42-79973
	Thermometer Indicator (Thermocouple Single), Type B-9	94-27928-A	42-79973 and up

c. Instruments Located on Floor (Refer to fig. 2-X).-

Ref. No.	Item	Part No.	Airplane No.
10.	Accumulator Air Pressure	S84-61-599	41-18774 and up
12.	Hydraulic Pressure	S84-61-579	41-18774 and up

d. In conjunction with the vacuum-operated instruments, the following units of the vacuum system are treated in this section:

Ref. No.	Item	Part No.	Airplane No.
	Air Filter, Vacuum Instruments	AN5822-1	41-18824 and up
	Valve, Suction Regulating, MK1-B	88-V-395	41-18774 to 42-80772
	Oil Separator, Eclipse No. 3278	Type 3-3	41-18774 to 41-18849
	Oil Separator, Pesco	NAF47089	41-18850 and up
	Vacuum Pump, Pesco	3P-207-J-A	41-18774 and up

e. Instruments in Gunner's Cockpit.- There are no instruments in the gunner's cockpit, except for the first ten ships. Since these ships are allocated to special assignments, description of their instruments need not be enlarged upon here.

3. Altimeter.

a. Purpose and Use.- Altimeters are used to indicate:

(1) Altimeter Setting.- Altimeter setting is a pressure in inches of mercury and is the existing "station pressure" reduced to sea level in accordance with the U. S. Standard Atmosphere.

NOTE: "Station pressure" is the existing atmospheric pressure at the elevation of the Weather Station and is not corrected to the elevation of the landing runway.

(2) Field Elevation Pressure.- Field elevation pressure is existing atmospheric pressure in inches of mercury at a point ten feet above the mean elevation of the runway, as it is assumed that the altimeter in an airplane is ten feet higher than the landing surface.

b. Description.- The altimeters found on the A-25A Airplane are of the sensitive type using an aneroid mechanism. The mechanism is composed of a rocking shaft assembly, calibration arm, sector, multiplying gear train and hand-staff, and hairspring secured to a member of the gear train and anchored to the mechanism plate. The instrument is calibrated to 35,000 feet, and a zero setting scale graduated in inches of mercury is set into the dial. A setting knob at the bottom front rotates the barometric scale. The instrument is sealed within its case and is vented, at the rear, only to the pitot static system. Accurate operation of the instrument is dependent on this vent, since the reading must be taken from undisturbed (static) air.

c. Maintenance.- The general points as outlined in paragraph 1 of this section applies to the altimeter. Other than these, there is very little repair that can be made.

d. Calibration of Altimeter in Airplane.-

(1) To calibrate altimeter in airplane, first take a portable altimeter, to the control tower and set pointers to read the surveyed elevation of the station altimeter above sea level. Vibrate the instrument before taking the reading. The pressure scale of the portable altimeter should read the existing "altimeter setting." If it does not, loosen the zero setting adjustment screw just to the left of the setting knob and displace it to the left. Do not remove screw. Then, with the pointers still reading the elevation, pull out on the setting knob and turn it until the pressure scale does read the existing altimeter setting. Check this carefully and vibrate it. Then push knob in, move the screw back to the right, and tighten it. The portable altimeter now reads correctly for the existing altimeter setting and the scale correction is zero for this pressure.

(2) Carry the portable altimeter to the altimeter in the airplane to be tested being sure to leave the pressure scale set to the existing altimeter setting. Set the reference markers on the airplane altimeter to zero, read the pointer indication, and determine the scale correction for this pressure altitude. Now vibrate and read the portable altimeter and subtract the correction, which has just been determined for the airplane's altimeter from this reading; set the pointers of the altimeter to read this value, tapping the instrument sufficiently to remove all friction. The pressure scale of the airplane's altimeter should read the existing altimeter setting as set on the pressure scale of the portable altimeter.

(3) If, after this procedure, the airplane's altimeter does not indicate the existing altimeter setting, loosen the adjusting screw to the left of the knob (do not remove the screw), and displace it to the left. Then pull out on the knob and turn until the pressure scale does read the existing altimeter setting, keeping the pointers on the corrected reading determined in the preceding paragraph. Tap the altimeter during this procedure to remove the friction. If the pointers read properly, and the pressure scale reads the existing altimeter setting, move the screw back to the right and tighten. The airplane's altimeter is now set to the proper correction on its scale correction card, and all the other corrections appearing thereon should be applicable for other altitudes.

NOTE: Scale correction cards will not be prepared from data obtained during tests with open mercurial manometers, or so called "master" altimeters. Correction cards will be prepared **ONLY** from data obtained during tests against standard mercurial barometers at Air Corps Depots or during original acceptance tests.

4. Clock Assembly.

The clock operates in the conventional manner. The dial is numbered in the regular fashion and, except for the sweep-second hand, is similar to all eight-day clocks.

The ordinary maintenance of clocks consists of winding, setting, checking for accuracy, and regulation.

a. In winding, no greater force should be used than is absolutely necessary. The clock is fully wound when the stem offers a slight resistance to further winding and any attempt to wind beyond this point will result in damage to the mechanism.

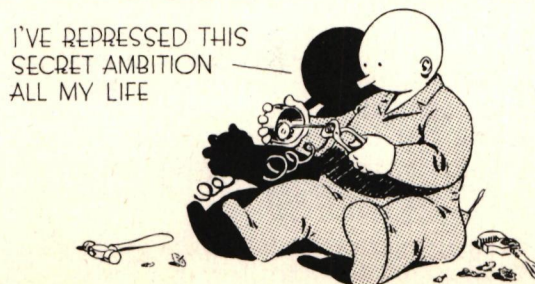
b. In checking for accuracy, the second hand is checked against the second hand of another clock or watch of known accuracy for a period of not less than one hour.

c. To Regulate.- The regulator is located under the large plug on the back of the case. This may be removed and the regulator moved towards "F" if the clock runs slow, or towards "S" if the clock runs fast. One degree will correct an error of approximately 15 seconds.

d. Any necessary repairs or overhaul of the clock will be done at a repair depot only.

5. Engine Gage Unit.

a. Description.- The engine gage unit em-



bodies three indicating mechanisms. It provides a visual means of showing the engine oil temperature, the oil pressure, and the fuel pressure. The temperature of the engine oil is remotely indicated through a conventional Wheatstone bridge circuit, calibrated in degrees of temperature from zero to 120 degrees C (32 to 248 degrees F). The oil pressure mechanism is a regular bourdon tube assembly, with the dial of the instrument calibrated from zero to 200 pounds per square inch. The fuel pressure mechanism is designated to indicate the difference between the air and fuel pressures at their respective inlets to the carburetor. This is accomplished by the operation of two bourdon tubes, one of which is vented to the atmosphere while the other is connected to the fuel system at the carburetor inlet. The gage is calibrated from zero to 25 pounds.

b. Purposes.-

(1) Oil Temperature.- This gage indicates, while the engine is being warmed up on the ground, when the engine has reached a temperature sufficient for take-off.

(2) Oil Pressure.- This gage indicates the pressure at which lubricant is being forced to the various parts of the lubricating system. By indicating a loss of pressure, it warns of impending engine failure. It indicates to the pilot or mechanic that oil is circulating under proper pressure before take-off and it provides a means of measuring oil pressure during adjustment of the oil relief valve.

(3) Fuel Pressure.- When pressure drops, due to failure of any part of the fuel system, it warns of impending engine failure. Before take-off, it indicates the correct functioning of the fuel pump, the fuel pump relief valve, and, to a certain extent, the entire fuel system. When switching from one fuel tank to another, it will indicate uninterrupted flow and will help to properly adjust the fuel pressure relief valve.

c. Maintenance.- The general instructions as outlined in paragraph 1 of this section applies to this gage. However, cold weather may sometimes congeal the engine oil in the oil pressure gage line and cause the gage to be sluggish when the engine is started. When this condition prevails, the gage line will be drained and refilled with hydraulic fluid, Specification No. AN-VV-O-366a. This is accomplished by the following method.

(1) Disconnect the oil pressure line at both the instrument and at the engine and drain out all the heavy oil. If compressed air is available, the line should be blown free.

(2) Solder a fitting, threaded to connect to the engine end of the oil pressure gage line, to the nozzle of a plunger-type oil gun.

(3) Fill the oil gun with hydraulic fluid (Specification No. AN-VV-O-366a) and connect the gun to the gage line. Slowly force hydraulic fluid into the line until a small amount runs out at the instrument end. Then connect the line to the gage, without withdrawing the pump plunger, and carefully tighten the connecting nut.

(4) Remove the oil gun and connect the line to the engine.

6. Tachometer Indicator, and Generator.

a. Description.- The magnetic-drag tachometer is designed for remote indication of engine speed. The equipment consists of a generator coupled to the airplane engine and an indicator mounted on the instrument panel. The generator transmits electric power to a synchronous motor, which is part of the indicator. The frequency of this power is proportional to the engine speed. By applying the magnetic-drag principle to the indicating element, an accurate indication of engine speed is obtained. Calibration on the large circumference of the dial is in hundreds, further divided into tenths. The smaller pointer indicates "thousandths" of revolutions per minute.

b. Maintenance.-

(1) The general points on maintenance of instruments in part 1 of this section are applicable to this instrument.

(2) The generator and indicator units are sealed units and any repairs or adjustments to the internal mechanism are major repairs.

(3) No lubrication of either unit is required in the field.

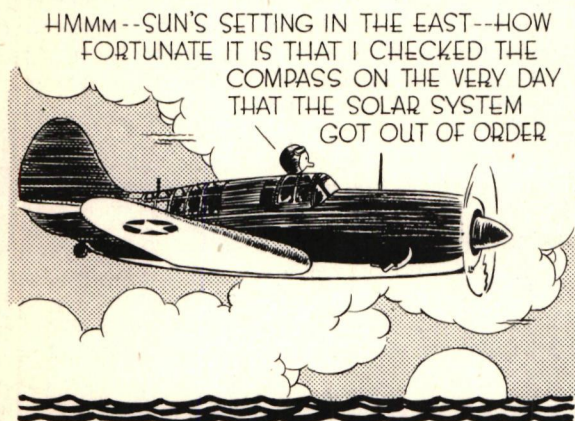
7. Compass and Dependent Units.

a. General.- The remote indicating compass system provides a means for locating the magnetic element of the compass as far from the engines, machine guns, moving turrets, and armor plate as possible. The less compensation that is necessary, the better will be the performance of the compass. In the A-25A Airplane, the transmitting element is installed, therefore, in the vertical fin, where it is as free as possible from local magnetic disturbances.

b. Installation.- Before wiring, the indicators and transmitter must be installed in the airplane.

Fig. 3-X is a complete wiring diagram of the compass installation. The electrical connections to both the indicators and transmitter are made to the AN standard disconnect plug receptacle on each unit. It is essential to connect like-designated terminals together between the transmitter and the indicator. The "B" terminal is common to both receptacles and must be externally grounded at the junction box. This ground must be made at only one point. It is very important that a good ground connection is made. An intermittent contact on the "B" circuit will place a heavy strain on the transmitter and may affect the calibration of the instrument. Care must also be employed to avoid any reversal of leads between the transmitter and indicator, since such reversal will cause incorrect indication.

After the installation has been completed and thoroughly checked, switch on the rated power for the compass system with the engines not running. The indicators should read the approximate heading of the aircraft. With the rated power still on, start the engine. Slowly turn the airplane approximately 90 degrees and observe the indicators. Turn off the engines and



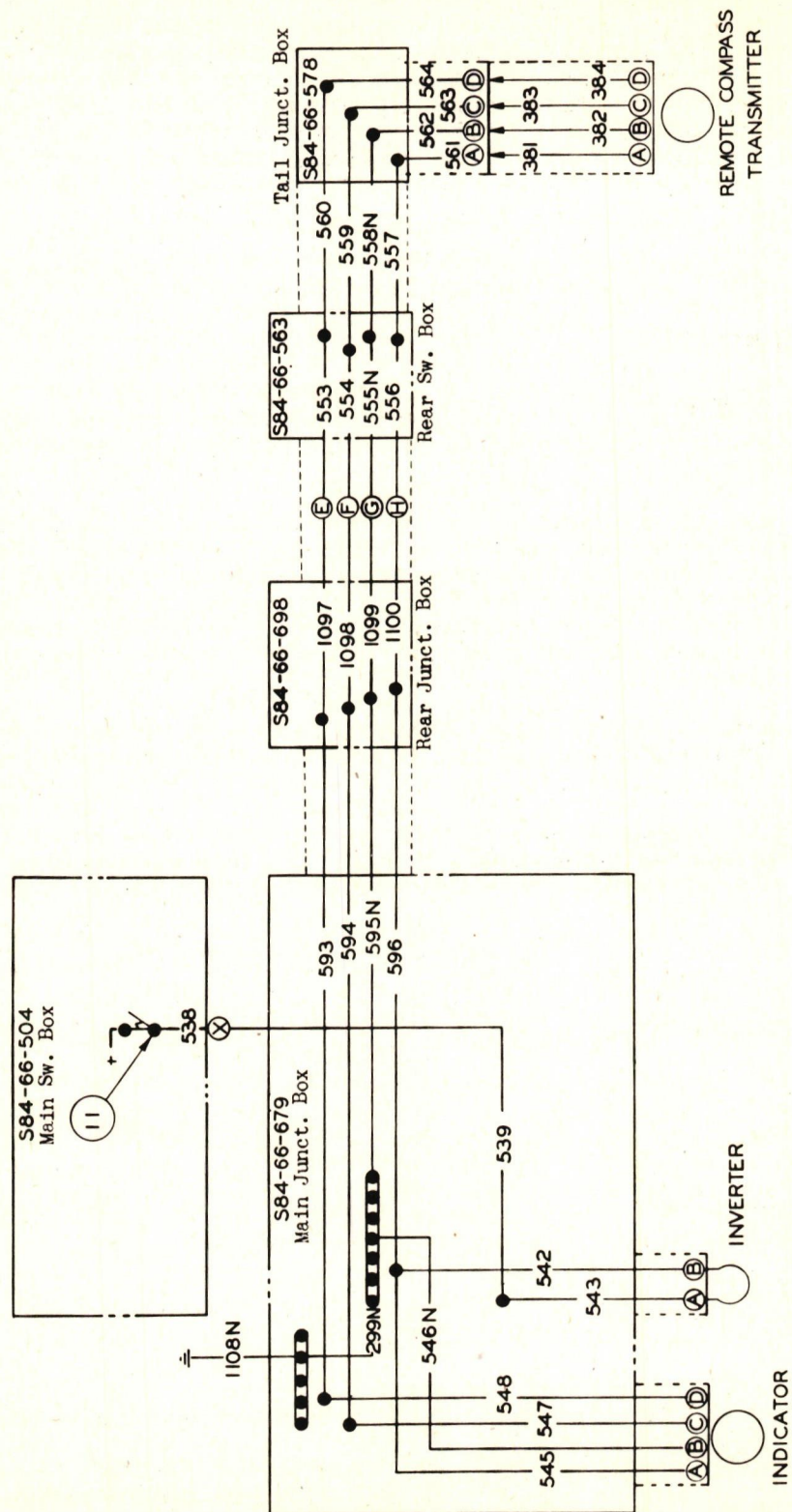
note the indicator readings. Swing the aircraft approximately 90 degrees and note whether the hands of the indicators move in the direction of the new heading. If the hands fail to do so, the wiring is not continuous or one of the compass units is defective. The wiring and the individual units of the system must be checked as suggested hereafter in this section.

NOTE: The above routine must be performed in a location that would be favorable for compensation, that is, a place as free as possible from local magnetic disturbances.

c. Compensation.- Prior to compensation on an airplane, certain conditions must be observed. Select a place for swinging the ship that is free from artificial magnetic disturbances such as power lines, pipes, steel structures, etc. After securing all guns, ammunition, and movable equipment in their service positions, raise the tail of the airplane so that the normal cruising angle-of-attack is simulated. Check the compensator on top of the transmitter to be sure that the two white dots on the compensator's drive-screws line up with the two white dots between the letters NS and EW on the compensator front plate. When these dots are aligned, the effect of the compensator on the compass element is nullified.

With all units properly installed and correctly wired, turn on the power. Also start the engine of the airplane so that flight conditions are simulated as nearly as possible.

Place the airplane on a compass rose and, without changing the setting of the compensators, head the airplane successively magnetic north, east, south, and west. Note the deviation in each case and give the deviation a plus sign if the compass reading is too large and a minus sign if the compass reading is too small. Find the total of all the deviations by adding where the signs are plus and subtracting where the signs are minus. Divide the result by four. This will give the average deviation. If the sign of the average deviation is plus, rotate the transmitter in its mounting so that the reading on the indicator is decreased by an amount equal to the average deviation. If the sign of the average deviation is minus, rotate the transmitter



so that the reading on the indicator is increased by an amount equal to the average deviation. The heading of the airplane when this last operation is performed is not important. This procedure will remedy any small misalignment incurred in installing the transmitter.

With the plane still on the compass rose, head it magnetic north. With a non-magnetic screwdriver, turn the screw marked N-S on the transmitter compensator until the indicator unit indicates north (0 degrees). Head the plane east (90 degrees) and turn the compensating screw marked E-W until the indicator reads east (90 degrees). Head south (180 degrees) and, if the indicator does not indicate south, turn the N-S screw to eliminate one-half the error. By so doing, the error is divided between the north and south headings. Head the ship west (270 degrees) and, if an error appears, remove one-half the error by adjusting the E-W compensating screw.

When compensation has been completed, swing the ship through 360 degrees, check the heading every 30 degrees, and note the indications for each heading on the correction card.

d. Servicing and Inspection. -

(1) Isolating Troubles. - Before returning an instrument to the repair depot, it should be definitely determined whether the source of trouble is in the indicator or the transmitter. This can be readily accomplished by employing a master transmitter 13522-1-A, which has a pointer that can be rotated by hand.

With the power of the compass system, off, disconnect the plug of the installed transmitter. Connect the master transmitter to the disconnect plug of the cable. Switch on the power supply and manually turn the pointer of the master transmitter. If the indicators are observed to "follow" correctly and in step with the master transmitter, the trouble source is in the transmitter. If it fails to "follow" correctly, the trouble is in the interconnecting cables, or in the installed indicators. The wiring may be checked readily with an ohmmeter and the trouble source thus isolated.

For any service or adjustments to the internal parts of the compass unit, the faulty indicator or transmitter must be removed from the airplane and forwarded to the repair depot in accordance with T. O. No. 05-1-1.

(2) Electrical. - As an aid in locating wiring errors, the following table shows wiring faults. All indicator behavior is considered as referred to a transmitter pointed on a north landing. Letters used, refer to wires corresponding to plug terminal pin markings anywhere in the circuit. Refer to fig. 3-X.

<u>Troubles</u>	<u>Causes</u>
(a) No torque.	1. "A" shorted to "B." 2. Power supply not operating.
(b) Reverse rotation.	1. "A" and "B" reversed with "C" and "D" reversed.
(c) Erratic operation in 90 degree arc between 330 degrees and 60 degrees.	1. "C" open.
(d) Erratic operation in the 90 degree arc between 300 degrees and 30 degrees.	1. "D" open.
(e) Pointer pulls in at both 30 degrees and 210 degrees. That is, at either of these headings, the pointer is pulled away in one direction or the other.	1. "A" wire open (power supply reaching one unit). 2. "D" shorted to "A" or "B." 3. "A" - "D" phase open in either transmitter or indicator coils. 4. "A" and "D" reversed.

- | | |
|---|--|
| (f) Pointer pulls in at both 330 degrees and 150 degrees. | <ol style="list-style-type: none"> 1. "B" wire open (power supply reaching one unit). 2. "C" shorted to "A" or "B." 3. "B" - "C" phase open in either transmitter or indicator coils. 4. "B" and "C" reversed. |
| (g) Erratic operation in the 120 degree arc between 300 degrees and 60 degrees. | <ol style="list-style-type: none"> 1. "C" - "D" phase open in either transmitter or receiver coils. |
| (h) Pointer pulls in at both 0 degrees and 180 degrees. | <ol style="list-style-type: none"> 1. "A" and "C" reversed with "B" and "D" reversed. 2. "A" and "D" reversed with "B" and "C" reversed. |
| (i) Pointer pulls in at both 60 degrees and 240 degrees. | <ol style="list-style-type: none"> 1. "A" and "C" reversed. |
| (j) Pointer pulls in at both 120 degrees and 300 degrees. | <ol style="list-style-type: none"> 1. "B" and "D" reversed. |
| (k) Pointer pulls in at both 90 degrees and 270 degrees. | <ol style="list-style-type: none"> 1. "C" shorted to "D." 2. "C" and "D" reversed. 3. "A" and "B" reversed. |

(3) **Mechanical.** - When it has been established that all wiring is correct, it should then be determined whether the mechanical parts of the units are in good condition. There are certain troubles, listed in the following table, which may be of assistance in identifying and eliminating difficulties in the mechanical elements of the units.

<u>Troubles</u>	<u>Causes</u>	<u>Remedies</u>
(a) Swirl of liquid giving erratic indication.	1. Not enough liquid in bowl.	a. Forward to repair depot for filling.
(b) Leakage of compass liquid.	1. Leaky gaskets.	a. Forward to repair depot for replacement with impregnated gaskets.
(c) Compensator does not have sufficient effect.	1. Weak compensation magnets.	a. Forward to repair depot for re-magnetization of compensator magnets.

Indicator

(d) Erratic indication.	1. Loose pointer.	a. Forward to repair depot for proper fitting on the rotor extension, or replacement.
(e) Sluggish operation.	1. Dirty jewels.	a. Forward to repair depot for cleaning of jewels.
	1. Dirty pivots.	a. Forward to repair depot for cleaning of pivot.

8. Air speed Indicator and Air speed Pitot Tubes.

a. **General.** - The air speed indicator contains a mechanism which responds to small differential-pressure changes in an accurate and sensitive manner. Each instrument contains a phosphor-bronze or beryllium-copper diaphragm capsule sufficiently sensitive to move under very slight changes of pressure, and a linkage for transmitting the motion of the diaphragm to the pointer. The dynamic pressure from the pitot tube is transmitted to the interior of the

diaphragm capsule. The static pressure from the static tube is transmitted to the interior of the otherwise airtight indicator case and affects the outside of the diaphragm capsule, which thus responds to the difference between the pitot and the static pressures.

The reliability of an air-speed indication is dependent upon the pressures delivered by a pitot-static air-speed tube and the response of the mechanism of an air-speed indicator to these pressures. Because of greater reliability, as compared to pitot-venturi tubes, electrically-heated pitot-static air-speed tubes have been made the standard for Air Corps. The pitot-static air-speed tubes are practically free from errors resulting from slight deposits of dust, oil, or water, while electrical-heating will prevent ice formation on the tube under the most severe icing conditions. The air-speed tube actually consists of two tubes. The inner tube, open to the front, delivers the dynamic pressure to the air-speed indicator. The outer tube, through its circumferential slots or holes, will deliver static pressure (pressure of still air).

As the speed of the plane increases, the pitot pressure inside the diaphragm causes the latter to expand. The rocking shaft picks up the motion by means of its diaphragm lever and, in turn, transmits this motion through the long lever, to the sector, and finally to the hand-staff pinion. The pointer fastened to the hand-staff indicates air speed in miles per hour.

The indicator consists primarily of an airtight diaphragm assembly and a mechanism for multiplying its deflection. The mechanism is composed of a rocking shaft assembly with diaphragm lever and a long lever, a sector assembly with a sector lever, and hand-staff pinion. A hair spring secured to the hand-staff and anchored to the mechanism body removes backlash from the mechanism and holds the diaphragm lever against the diaphragm bridge. The entire mechanism is housed in an airtight case. The pitot tube is connected to the interior of the diaphragm and the static tube to the case.

b. Testing of Lines.

(1) Static Lines, Suction. - With the instruments properly connected to the static pressure line, the static pressure slotted openings or holes of the air-speed tube shall be suitably connected to a source of suction. The altimeter pointers shall be set to indicate zero. A suction shall be slowly applied in sufficient amount to cause the altimeter pointers to indicate 1000 feet of altitude (approximately 1.05 inches of mercury or 14.24 inches water, suction) at which point the source of suction shall be "pinched off." During a period of one minute, the altimeter pointers shall not change their position by more than 150 feet. (They shall not indicate less than 850 feet of altitude.) The altimeter or instrument board shall be tapped during the one minute period, to remove the friction effect from the indication of the pointers.

NOTE: DO NOT APPLY PRESSURE TO STATIC PRESSURE LINE.

Regulate the slow application and removal of suction by means of the indication of the rate of climb indicator which should not exceed 200 fpm.

(2) Pitot Lines, Pressure. - The pitot pressure chamber drain holes of the air-speed tube shall be sealed. With the air-speed indicator properly connected to the pitot pressure lines, the pitot pressure opening of the air-speed tube shall be suitably connected to a source of pressure. A pressure shall be slowly applied in sufficient amount to cause the air-speed indicator pointer to indicate 150 mph (approximately 0.82 inches of mercury or 11.18 inches water pressure) at which point the source of pressure shall be "pinched off." During a period of one minute the air-speed pointer shall not change its position by more than 10 mph. (It shall not indicate less than 140 mph.) The air-speed indicator or instrument board shall be tapped during the one minute period to remove the friction effect from the indication of the pointer.

NOTE: DO NOT APPLY SUCTION TO PITOT LINES.

The connection of the air-speed tube and of the indicator case are marked P (pressure) and S (static). Be sure to have tube lines run between like-lettered connections.

9. Bank and Turn Indicator and Dependent Units.

a. Purpose. - The bank and turn indicator is used for controlling flight under conditions of poor visibility or when, for any reason, it is desirable to eliminate any yawing or turning. It

is a combination of two flight instruments. The bank indicator unit is a ball-type inclinometer, a simple, pendulous device. The ball rolls in a curved glass tube filled with damping liquid and gives an indication of the lateral stability of the airplane in straight flight and turns. The turn indicator consists of an air-driven gyroscope with one degree of freedom and indicates the rate of turn.

b. Maintenance.-

(1) The general points on maintenance as outlined in paragraph 1 of this section are applicable to this instrument.

(2) 100-Hour.- Check installation for suction connections. Remove plug under word "oil" on the right side of the case and add lubricant as follows:

For operating conditions in which atmospheric temperatures are above freezing (0 degrees C or +32 degrees F) add eight drops of oil, gyro instrument, Specification No. AAF-3563.

For operating conditions in which atmospheric temperatures are below freezing (0 degrees C or +32 degrees F) add eight drops of a mixture of 1/3 liquid compass, Specification No. AN-VV-C-551 and 2/3 oil, gyro instrument, Specification No. AAF-3563.

Care should be exercised that all of the oil is inserted in the rotor pivot. A fine wire (approximately .015-inch diameter) should be used to guide the oil into the hole in the pivot. Any excess of spilled oil may be a source of unsatisfactory operation.

To perform the above lubrication, the bank and turn indicator must be removed from the airplane.

The jet cover, which is located on the top of the instrument case at the rear, should be removed and cleaned. The filter may be disassembled from the cover by removing the two spring clamps which hold it in place.

The drain plug, which is located on the bottom of the instrument near the front, should be removed to allow collections of oil and water to drain out of the instrument.

Ground-test the suction at the instrument under normal cruising rpm of the engine. To make this test, connect a type F-1 or F-2 suction gage to the plugged connection on the bottom of the instrument. The suction should be between 1.80 and 2.05 inches of mercury. The source of suction should be the vacuum pump on the engine.

Under normal flight conditions, a vacuum of 1.80 or 2.05 inches of mercury shall be provided in the case of the instrument. It is necessary to check the amount of suction after the installation has been completed, by connecting a suction gage to the connection in the instrument case which is not in use. After removing the gage, be sure to replace the 1/8-inch pipe plug. Otherwise the instrument will not function.

It is desirable to have a deflection of one pointer width (5/32-inch) for rate of turn of 180 degrees per minute at cruising speed. Due to varying temperature and individual instrument characteristics, the vacuum of 1.80 to 2.05 inches of mercury will not always produce this desired sensitivity. The vacuum should be set to produce this deflection wherever practicable during a flight test. The adjustment of the restricting needle valve may be made by reaching under the instrument board. Increasing the vacuum (screwing the valve stem out) increases the sensitivity and amount of deflection, and decreasing the vacuum (screwing the valve stem in) decreases the sensitivity and amount of deflection.

Before a new instrument, or an instrument which has been received from stock is installed, add approximately six drops of a mixture of 1/3 liquid, compass, Specification No. AN-VV-C-551, and 2/3 oil, gyro instrument, Specification No. AAF-3563, to the rotor pivot previously described under Inspection and Maintenance.

10. Rate of Climb Indicator.

a. Purpose and Description.- This instrument is designed to show gain or loss of altitude

regardless of the attitude of the airplane. It is essentially a sensitive type of manometer. It operates from the differential between atmospheric pressure and the pressure of the thermos chamber which is vented to the atmosphere through a small calibrated leak. The instrument serves a very important function when used to govern throttle setting in blind flying. It aids the pilot in maintaining a definite vertical velocity of the aircraft in a climb or dive, but does not indicate the angle of the aircraft with respect to the horizontal. In other words, it shows the vertical component of the speed of the airplane.

b. Maintenance. -

(1) The general points on maintenance as outlined in part 1 of this section are applicable to this instrument.

(2) Service troubles and remedies:

<u>Troubles</u>	<u>Causes</u>	<u>Remedies</u>
(a) Pointer off zero	<u>1.</u> Mechanism shift.	<u>a.</u> Return pointer to zero by means of a knob. Tap while making adjustment.
(b) Pointer off zero and cannot be brought back by zero adjusting knob.	<u>1.</u> Broken pivot.	<u>a.</u> Replace.
(c) Pointer fails to respond.	<u>1.</u> Obstruction in static line.	<u>a.</u> Disconnect all instruments which may be connected to the static line. Open drain plug and blow line clear.
(d) Instrument indicates less than actual rate of climb.	<u>1.</u> Case leak. <u>2.</u> Broken diffuser.	<u>a.</u> Find leak and correct. <u>b.</u> Replace diffuser assembly.
(e) Pointer oscillates.	<u>1.</u> Leaks in static line.	<u>a.</u> Disconnect all instruments which may be connected to the static line. Check line for leaks. Check individual instruments for leaks.

11. Manifold Pressure Gage.

a. Purpose and Description. - The purpose of the manifold pressure gage is to show manifold pressures under various engine operating conditions. It is designed to measure absolute pressure and its operation is continuous. The dial is graduated in increments of one-inch mercury and numerals are placed at each five-inch interval on the scale. When the engine is not operating, the gage will register the prevailing atmospheric pressure, not zero. Operation of the engine with too low a manifold pressure will result in decreased power output, whereas an increase in pressure beyond a certain permissible overload will seriously endanger the engine.

NOTE: When the engine is idling, the absolute pressure in the manifold will be low (10 inches to 15 inches mercury); as the engine speed increases the pressure will increase.

The gage contains an aneroid diaphragm and linkage for transmitting the motion of the diaphragm to the pointer. The linkage mechanism is completely external to the pressure chamber, therefore it is not exposed to the corrosive vapors of the manifold. Manifold pressure enters the sealed chamber, which houses the diaphragm, through a damper tube. This tube is a capillary that acts as a safeguard in the event of engine backfire.

b. Maintenance. -

(1) The general points on maintenance as outlined in part 1 of this section are applicable to this instrument.

(2) At first evidence of excessive pressure fluctuation or other symptoms of malfunction, the gage should be returned to the repair depot.

(3) If, during inspection, the reading of the gage differs by more than four inches of mercury from that of the station barometer, the instrument should be marked for repair.

(4) No service lubrication is necessary for this gage.

12. Free Air Indicator and Dependent Units.

a. Purpose and Description. - The free air indicator records the temperature of the atmosphere outside the cockpit. This information is very important in the operation of aircraft, especially when the moisture content of the air is such that there is danger of icing formations on the lifting surfaces of the airplane. The temperature of the free air is also used, with the aid of altitude computers, to determine the true altitude of the ship. (True altitude is important when performing bombing missions or when navigation problems, involving the use of air speed, are to be solved.)

The principle of this type of thermometer (ratio-resistance) is based on the characteristic of all metals of changing their electrical resistance with changes in temperature. The thermometer bulb located in the left wing of the plane (see fig. 2-XIX) contains a sensitive resistance element, which is adjusted to have a specific resistance for each value of temperature, throughout its range. The indicator is a ratio-meter type indicator and its accuracy is maintained independent of voltage variations.

b. Maintenance. - The general points on maintenance as outlined in part 1 of this section are applicable to this instrument.

13. Fuel Gage Indicator and Transmitter.

a. General. - The A-25A is equipped with dc Selsyn fuel level indicating equipment, operating on a three-wire system, which requires the use of three leads to connect the transmitter to the indicator. The transmitter used in the three-wire system consists essentially of a circular resistance, upon which a pair of brushes operate. The winding is tapped in three places for connection to the indicator. The brushes are connected to the direct current battery supply. As the brushes are rotated, the voltage at the taps in the winding is varied, and a proportional variation occurs in the current flowing through the field coils of the indicator.

The indicating element, used in the three-wire system consists essentially of a core, rotor, and three field coils. The core is made up of circular laminations of a ferro-magnetic material. The three field coils are placed on the core at intervals of 120 degrees. The leads between the coils are connected to the three taps of the transmitter winding. As the voltage at the transmitter taps is varied, the distribution of current in the indicator coils is affected and the direction of the magnetic field across the indicating element is changed. As the magnetic field changes direction, the polarized rotor follows it. Because there are no springs or restraining forces on the rotor, its movement is independent of the battery voltage. Likewise, since the coils are arranged symmetrically, its position is not affected by changes in coil resistance occurring with changes in temperature.

In the three-wire system, the whole transmitter coil is utilized, and the three taps in the coil are evenly spaced. The three coils of the indicating element are likewise evenly spaced around the circular core. Because of the symmetrical characteristics of the transmitting and indicating elements, the correspondence in movement between the transmitter brushes and the indicating-element rotor is inherently close. Calibration of the equipment further improves the accuracy of the power. When control magnets are used to pull the pointer to a definite "POWER OFF" position, it is always desirable to calibrate the indicator in order to offset the slight effect of the magnet on scale distribution. Refer to fig. 2-XI for the fuel gage wiring diagram.

b. Installation. -

(1) Indicator. - The installation of the indicator should be evident. Self-locking nuts are provided on the instrument.

(2) Transmitter.- Insert the transmitter through the tank opening and, with the receptacle in the proper position, fasten the transmitter to the tank with the screws provided with the instrument.

Adjust for empty tank condition as described in the following paragraph.

c. Adjustment of Fuel Level Gages.- The tank must be empty so that the float will rest on the bottom of the fuel tank.

(1) Connect the transmitter and indicator in accordance with the electrical wiring diagram.

(2) Loosen the four screws on top of the transmitting element assembly and rotate the adjusting disc until the pointer reads zero. Tighten the four screws.

(3) In the event that it is not possible to get an empty tank adjustment by merely rotating the adjusting disc, it will be necessary to make the following additional adjustment: Loosen the four screws on top of the transmitting element and rotate the adjusting disc so that it is at its mid-point of travel. Tighten the screws slightly to hold the adjusting disc in place. Note the reading on the indicator and then remove the six screws which hold the transmitting element to the mounting flange of the transmitter. Remove the transmitting element and rotate the shaft to a position where the indicator will read the same as the reading taken above. Determine and mark the position of the arrow with respect to the tank so that when the transmitting element is assembled to the shell, the receptacle and the float arm will be in their correct position. With the shaft in this position, make a small pencil mark on one end of the magnet and a mark on the case of the element directly opposite this end of the magnet. Next grasp the transmitting element. Push the magnet against the spring and rotate the shaft until the cross pin aligns with the notch in the magnet, which makes the indicator read nearest to zero when the mark on the magnet and on the case are realigned. When the magnet has been released, this constitutes a rough empty tank adjustment. Replace the transmitting element in the shell and secure it in place with six screws. Now loosen the four screws on top of the element and rotate the adjusting disc mentioned above until the indicator reads exactly zero and then tighten and safety the four screws holding it in place.

d. Maintenance.-

(1) Indicator.- Check the indicator for lag or sluggish operation by turning on the battery and fuel gage switch and noting the action of the pointers. They should snap into position without appearing sticky or showing signs of lag. When the power is turned off, the pointers should pull off scale. If the pointers appear sticky or show signs of lag, the indicator should be removed from the instrument panel and sent to a repair depot for cleaning or overhaul.

If the glass is broken, clean the instrument and install a new gasket. When the glass becomes loose, add a thicker gasket under the glass.

(2) Transmitter.- Remove the transmitter from the fuel tank and check for freedom of motion as follows: Raise the float arm as high as possible and then allow the float to fall slowly, by holding a finger under the float arm and lowering it. The float arm should show no signs of stickiness and should continue to fall to a vertical position. This should be tried on both sides of the vertical position. If the operation appears to be sticky, all bearings and gears should be inspected to determine the point of stickiness.

Connect the transmitter to an indicator known to be in good working order. Move the float arm continuously in one direction and note the movement of the indicator pointer. If the indicator pointer moves continuously in one direction, the transmitter operation is correct. If the indicator pointer hesitates or momentarily moves backward, there is a poor connection in the transmitter. The transmitter should be returned to the depot for overhaul.

If the resistance winding is found to be burned out, the external circuit should be checked and any faults corrected before a new resistance winding or instrument is installed.

14. Directional Gyro.

a. General.- The gyro contained in the directional gyro indicator is simply an air-driven rotor, universally mounted so that its spin axle can assume any position in space.

The rotor of this instrument spins about the lateral axis on bearings in a gimbal ring. The gimbal ring is free to turn about the longitudinal axis of the airplane on bearings in the vertical ring. The vertical ring is free to turn about the vertical axis. The circular card, which is attached to the vertical ring, is observed by the pilot through a rectangular opening in the front of the case. Obeying the gyroscopic principal of "rigidity," the rotor, gimbal ring, the vertical ring (and attached card) remain fixed in azimuth as the airplane turns. The card is observed in relation to the lubber line on the front of the instrument in the same manner as a compass.

The caging knob is used initially to set the directional gyro indicator with the magnetic compass and later to reset it at periodic intervals. When the knob is pushed in, it engages the synchronizer pinion with the synchronizer gear. The synchronizer lever plunger is also engaged, and raises the lever pins which slide in a groove in the synchronizer ring. This lifts the synchronizer ring, pushing up the spring plungers, and raising the caging arm so that it makes contact with the bottom of the gimbal ring and holds the gyro horizontal, as the card is turned to the desired heading. Pulling the caging knob out releases the caging mechanism and leaves the gyro horizontal and free (uncaged).

b. Installation and Removal. - The installation and removal of this instrument should be evident; however, the following precautions should be noted.

- (1) Remove the shipping plug from opening on back of case marked "AIR INLET."
- (2) Connect the instrument to the engine-driven vacuum pump using the more convenient of the three outlets on the back of the instrument. Keep unused outlets tightly plugged.
- (3) Keep tubing as short as possible and avoid sharp bends. Be sure that the tubing and flexible connectors are not pinched, twisted, or kinked.
- (4) The instrument should be operated on a vacuum of 3.5 to 5 inches of mercury.
- (5) The gyro should be caged at all times when the engine is not running.

c. Maintenance. -

(1) General. - A directional gyro indicator, if properly installed, should not require overhaul in less than three or four hundred hours of operation, and should not require attention other than replacement of the filter or cleaning of the air screen during this period. Any trouble encountered will probably be due to a clogged filter, excessive vibration, or improper vacuum supply.

(2) Air Filters and Screens. - Replacement of the air filter disc or cleaning of the air screen in the instrument is not considered disassembly, and may usually be accomplished without removing the instrument from the airplane. The frequency of the cleaning or replacing of air filters and screens will depend upon service conditions; however, this maintenance should be performed approximately every fifty hours of operation.

If the adapter cover is in place, remove it by taking out the four fillister-head machine screws. Lift out the snap ring which holds the filter in place; remove the filter and replace it with a new one. Replace the adapter (if installed) and secure it with screws.

If neither an external nor an internal air filter is installed, it will only be necessary to clean the air screen in the bottom of the instrument. Simply lift out the snap ring; remove the air screen; clean it and replace it with the snap ring.

CAUTION: Under no condition should the directional gyro indicator be disassembled by anyone not authorized to do so.

d. Service Troubles. -

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Excessive drift in either direction.	(a) Insufficient vacuum. If vacuum is below 3.5 inches of mercury, check as follows:	(a) Correct for insufficient vacuum as follows:

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
	1. Suction regulator improperly adjusted.	(1) Adjust suction regulator.
	2. Incorrect gage reading.	(2) Check calibration of gage.
	3. Pump failure.	(3) Replace pump.
	4. Vacuum line kinked or leaking.	(4) Locate and repair. Check for collapsed inner wall of flexible hose.
(2) Dial spins continuously in one direction.	(a) Defective mechanism.	1. Replace instrument.

e. Lubrication. - The shafts, pivots, and bearings of the instrument are lubricated before assembly in the case, and no further lubrication should be necessary until they are removed for inspection and overhaul. It should be remembered, however, that continuous use of the instrument in hot climate increases the evaporation of its oil, and replenishing may be necessary.

15. Gyro-Horizon.

a. General. - The gyro contained in the gyro-horizon indicator is an air-driven rotor, universally mounted so that its spin axle can assume any position in space. The rotor of this instrument is mounted in a housing and spins about a vertical axis. Any movement of the airplane around the longitudinal or lateral axis, with respect to the gyro, is shown on the face of the instrument by the horizon bar which is observed by the pilot with reference to a miniature airplane, which is part of the dial in front of the instrument

Gyro-horizon indicators are provided with caging devices to prevent damage to the instrument during acrobatics. When the caging knob is pulled and turned to the "OFF" position, the reference line points to "OFF" and the shield exposes a warning dot to show the pilot that the gyro is caged and the instrument is not indicating. When the caging knob is pulled and turned to the "ON" position, the reference line points to "ON" and the shield covers the warning dot, showing that the instrument is indicating.

b. Installation and Removal. - The installation and removal of this instrument should be obvious; however, the following precautions are necessary.

- (1) Remove shipping plug from opening on back of case marked "AIR INLET."
- (2) Connect the instrument to the engine-driven vacuum pump, using the most convenient of the three outlets on the back of the instrument. Keep unused outlets tightly plugged.
- (3) Keep tubing as short as possible and avoid sharp bends. Be sure that the tubing and flexible connectors are not pinched, twisted, or kinked.
- (4) The instrument should be operated on a vacuum of 3.5 to 5 inches of mercury.

c. Maintenance. -

(1) General. - The gyro-horizon indicator, if properly installed, should not require overhaul in less than three or four hundred hours of operation, and should not require attention other than replacement of the filter or cleaning of the air screen during this period. Any trouble encountered will probably be caused by a clogged filter, excessive vibration, or improper vacuum supply.

CAUTION: Under no condition should the gyro horizon indicator be disassembled by anyone not authorized to do so.

(2) Air Filter and Screen. - Replacement of the air filter or cleaning of the air screen in the instrument is not considered disassembly, and may usually be accomplished without removing the instrument from the airplane. The frequency of cleaning or replacing air filters and screens will depend upon service conditions; however, this maintenance should be performed approximately every 50 hours of operation.

If the air filter body cover is in place, remove it by taking out the four fillister-head machine screws, then remove the air filter body which contains the filter. Lift out the snap ring which holds the filter disc in place, remove the filter, and replace it with a new one. Replace the air filter body (and air filter body cover, if so installed), and secure it with the screws.

If neither an external nor an internal air filter is installed, it will only be necessary to clean the air screen in the back of the instrument. Simply lift out the snap ring; remove the air screen; clean it; and replace with the snap ring.

d. Service Troubles and Repairs.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Bar fails to respond.	(a) Instrument caged. (b) Air filter dirty (high vacuum indication). Reducing overflow. (c) Insufficient vacuum. If vacuum indication is below 3.5 inches of mercury, check as follows: 1. Suction regulator improperly adjusted. 2. Incorrect gage reading. 3. Pump failure. 4. Vacuum line kinked or leaking.	a. Uncage. b. Examine filter. Clean or replace if necessary. c. Correct for insufficient vacuum as follows: (1) Adjust suction regulator. (2) Check calibration of gage. (3) Replace pump. (4) Locate and repair. Check for collapsed inner wall of flexible hose.
(2) Bar does not settle.	(d) Defective mechanism. (a) Defective mechanism. (b) Insufficient vacuum. (c) Excessive vibration.	d. Replace instrument. a. Replace instrument. b. Correct for insufficient vacuum (see "c" above). c. Test with vibrometer. If amplitude is more than .004 inch, examine shock mounting and note whether connections are pulling on instrument.
(3) Bar oscillates or shimmies.	(a) Bar not completely uncaged. (b) Excessive vacuum. If vacuum indication is above 5 inches of mercury, check as follows: 1. Air filter dirty. 2. Suction regulator improperly adjusted. (c) Defective mechanism. (d) Excessive vibration.	a. Uncage. b. Correct for excessive vacuum as follows: (1) Clean or replace if necessary. (2) Adjust suction regulator. c. Replace instrument. d. (See c. above).

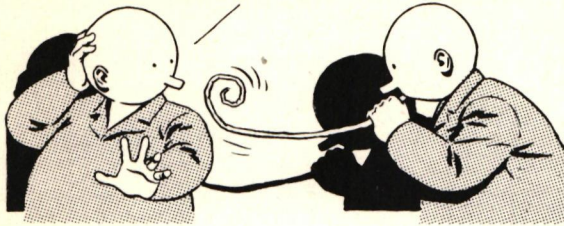
e. Lubrication.- The shafts, pivots, and bearings of the instrument are lubricated before assembly in the case, and no further lubrication should be necessary until it is removed for inspection and overhaul. It should be remembered, however, that continuous use of the instrument in hot climates increases the evaporation of the oil, and replenishing may be necessary.

16. Pressure Gages, Hydraulic System, Accumulator Air, and Engine Pump.

Pressure gages are installed to indicate the air pressure in the accumulator, the hydraulic

system pressure, and engine hydraulic pump pressure. These gages are of the bourdon tube type. The tube tends to straighten out as the pressure within increases. This movement of the free end of the spring is transmitted through a link to a geared mechanism which amplifies the motion to the pointer.

I'LL BE GLAD WHEN YOU'RE THRU WORKING
ON THAT BOURDON TUBE



Use no oil in the mechanism. Oil is not necessary for proper functioning of the gage, but will tend to make it sluggish at low temperatures. If the instrument fails to operate properly, it should be sent to the depot for repair.

The installation and removal of these instruments should be obvious; however, care must be taken to insure that no pressure remains in the system when removing a gage, and that the affected instrument is isolated so that

air will not be permitted to enter the entire hydraulic system.

17. Cylinder Head Temperature Gage.

a. General. - The cylinder temperature thermometer consists essentially of an indicator thermocouple and leads.

(1) In the operation of internal combustion engines for aircraft, it is essential to know the temperatures of such parts as the cylinder head, cylinder base, and often other temperatures whose control is essential for safe performance and highest efficiency. For instance, the gas and air mixture have a great effect upon the temperatures of the engine and, in the warming up of the engine, the temperature must be carefully watched to prevent damage due to overheating.

(2) As there is an upper temperature limit beyond which it is not safe to operate, it follows that temperature measuring equipment is necessary, and it is important that it be kept in accurate condition at all times.

(3) The indicator is a sensitive D'Arsonval type mechanism having a coil arranged to move in an annular air gap of a permanent magnet. The coil carries the pointer and the control is two phosphor-bronze springs which also serve to conduct the current into the coil. The thermocouple leads and the thermocouple are made of iron and constantan, to form a couple, one wire being iron, the other constantan. Constantan is an alloy of copper and nickel.

(4) The thermocouples and thermocouple leads are selected so as to have a definite electromotive force per degree within an allowable tolerance.

b. Installation. - Before the instrument is installed, the small piece of copper wire on the binding posts of the indicator must be taken off and discarded. This wire short circuits the instrument to prevent damage in shipping.

(1) All connections should be made clean and tight otherwise "Contact Resistance" will be introduced and the readings will be incorrect.

(2) After the thermocouple has been secured in position and connections made to the leads, the connectors should be anchored in some way, either by insulation tape or by a small clamp, to prevent flapping around and breaking, due to vibration. In any event, connectors should be taped to prevent shorting to engine.

(3) Attach the thermocouple lead to the thermocouple at the one end and to the indicator at the other end. The indicator end of the lead has two eye terminals with holes of unlike diameter, whereas the thermocouple end of the lead has one eye terminal and one terminal with a nut mounted on it. The plus and minus studs of the indicator are of unlike diameter. The indicator studs and lead terminals are so arranged that connections can be made in one way only. Correct polarity is thus assured.

IMPORTANT: The thermocouple leads must not be lengthened or shortened as they are of a definite resistance, and enter into the calibration of the indicator.

c. Maintenance. - Service maintenance should consist of such minor repairs as do not require disassembly of the indicator, such as:

- Replacement of leads,
- Replacement of thermocouple,
- Adjustment of pointer,
- Bench tests,
- Replacement of entire installation or the major units thereof.

18. Vacuum System (Refer to fig. 4-X).

a. General. - The suction required for the operation of the bank and turn indicator, the horizontal gyro and the directional gyro is provided by the vacuum system. The major units of this system are an engine-driven vacuum pump, an oil separator, a suction relief valve, a check valve, and the necessary lines and fittings.

b. The Engine-Driven Vacuum Pump. -

(1) Description. - This pump is of the rotary, four-vane, positive displacement type. Internal oil metering devices are incorporated in the pump to allow the proper amount of engine oil to enter the pump for correct lubrication.

(2) Operation. - The pump is coupled directly to the engine drive gear and functions continuously as long as the engine is running. Torque is transmitted from the engine drive gear to the pump rotor by means of a coupling. The bore of the sleeve is divided into four sections by the rotor and blades. Since the axis of the rotor is eccentric with that of the sleeve, the sections are of unequal volume, the smaller sections being next to the point where the rotor is closest to the wall of the sleeve. As the rotor turns, the four sections pass successively the point where the volume of each is at a minimum. From this point, the volume of each section increases during one-half revolution, thus creating a suction and drawing in air from the nearest port. During the second half revolution, the section volume decreases and the air is forced out through a second port. At normal operation speeds, the rapid succession of intakes produces a steady suction.

(3) Removal. - Disconnect the tubing to the ports of the pump and remove the nuts holding the pump to the mounting pad.

(4) Installation. -

(a) Remove the cover plate and gasket from engine pump pad and wipe the pad clean.

(b) Remove the shipping plugs from the two ports and test the pump for freedom of operation by turning the coupling with the fingers. If the pump is tight, wash it out with gasoline to remove any foreign particles. If this does not free up the movement, return it to the depot for repair.

(c) Make certain that the oil holes in the pad are aligned with the pump to insure proper lubrication.

(d) Place the gasket in position over the mounting studs and see that it does not block the holes in the pad. Install the pump, tighten the nuts, and safety.

(e) Connect the lines to the instrument and oil separator.

NOTE: Check the rate of lubrication of the pump before attaching the line to the oil separator. Attach a vented container to the line, to receive the vacuum pump discharge. Start the engine. Measure the oil discharged from the pump. It should not be less than three cubic centimeters in fifteen minutes at 1000 rpm.

(f) If ample lubrication is provided, complete the installation by carefully tightening all connections, properly supporting the tubing, and attaching all bonding.

(4) Maintenance. - Little attention need be given to the pump. It will be inspected every hundred hours for security of its mounting. It is overhauled at the time of engine overhaul.

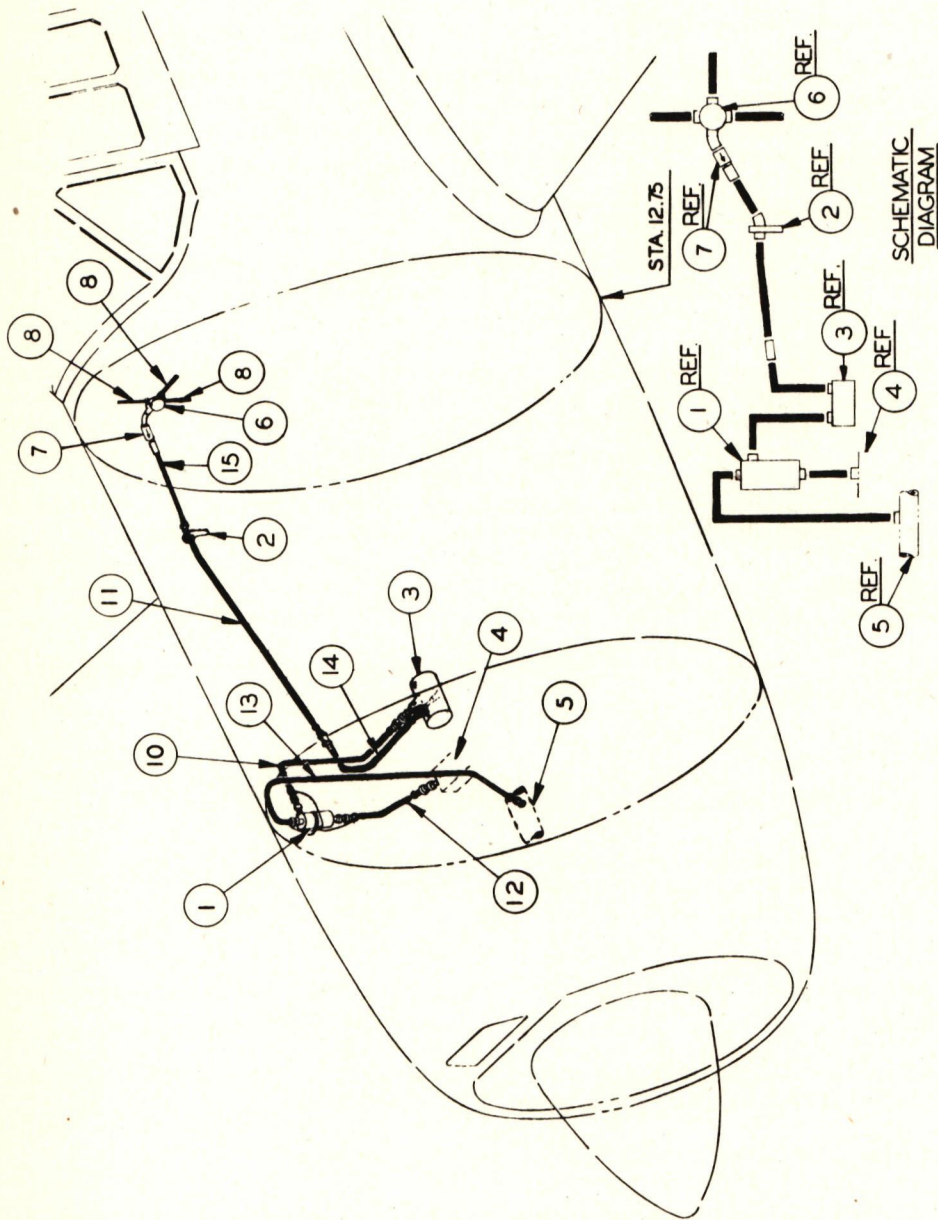


Figure 4-X - Vacuum System

PARTS LIST - VACUUM SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Oil Separator	Eclipse NAF 47089 *
2	1	Connector Panel	S84-44-544
3	1	Vacuum Pump	Pesco 3P-207-JA
4		Engine (Ref.)	
5		Exhaust Manifold (Ref.)	
6	1	Suction Regulating Valve	F.S.S.C-88-V-400
7	1	Check Valve	Pesco 226-A
8		Lines to Instruments (Ref.)	S84-SD61-01

* Oil separator No. 3278 type B-3 (Eclipse) is used on units 1 through 100.

LINE ASSEMBLY - VACUUM SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
10	S84-54-501-2	1	Oil Separator to Vacuum Pump	5/8 x .049	27.00	52SO	None None
11	S84-54-501-3	1	Hose Connection to Connector on Fire wall	5/8 x .049	26.75	52SO	AN818-10D None AN819-10
12	S84-54-501-6	1	Oil Separator to Engine	5/8 x .049	11.38	52SO	None None **
13	S84-54-501-8	1	Oil Separator to Exhaust Manifold	5/8 x .049	50.50	52SO	None None
14	S84-54-501-10	1	Vacuum Pump to Hose Connection	5/8 x .049	18.00	52SO	None None
15	S84-61-507-9	1	Connector on Fire wall to Check Valve	5/8 x .049	21.00	52SO	AN818-10D None AN819-10

** S84-54-501-951 (1/2 x .049 x 11.38) replaces S84-54-501-6 on units 1 through 100.

c. Oil Separator. - This unit serves to remove lubricating oil from the pump discharge air and return it to the crankcase. The oil separator is vented to the collector ring of the engine exhaust system. It is mounted on the upper, right-hand portion on the aft side of the engine bulkhead.

(1) Maintenance. - The separators will be removed, cleaned with a cleaning solvent (see T. O. 01-1-1), and dried with compressed air.

d. Suction Relief Valve. - The purpose of the suction relief valve is to keep the suction constant throughout the full range of pump speeds. This unit is essentially a spring-loaded type valve held against a screened valve seat by a spring whose tension may be altered by means of an adjusting nut outside the housing. The valve is adjusted to sustain a vacuum of four inches of mercury. A restriction placed in the line leading to the bank and turn indicator, balanced with a "bleed" in the instrument itself, reduces this pressure to two inches of mercury for this instrument alone.

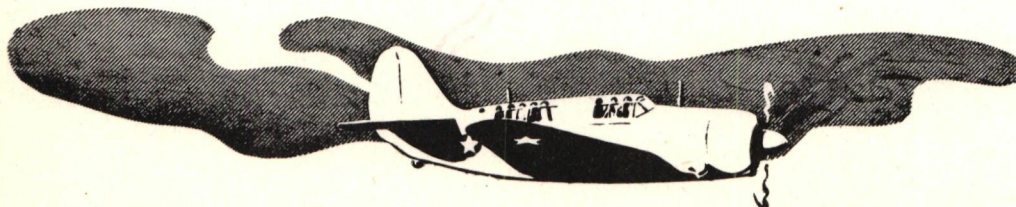
NOTE: This valve will always be mounted with the screen facing downward or to one side--NEVER UPWARD.

e. Check Valve. - This is a safety valve, incorporated into the system to protect the pump from overheating in the event of excessive back-pressure.

f. Lines and Fittings. - All vacuum system lines are marked with white and green bands. Fittings and couplings are of the usual type. Flexible connections are secured by one clamp on each end. They require no maintenance other than periodic checkups for security of attaching or mounting. In replacing lines, avoid sharp turns and kinks.

g. Troubles and Remedies. -

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Excessive oil in discharge.	(a) Excessive oil flow to pump, or clogged separator.	1. Check venting plugs to make sure they are installed properly and that pressure plug holes are not plugged. Remove separator drain fittings and clean. Check engine drive to insure that engine drive seal is not leaking excessively.
(2) High suction.	(a) Suction relief valve screen clogged.	1. Remove and clean.
(3) Low suction.	(a) Suction relief valve leaks. (b) Pump failure.	1. Replace valve. 2. Replace pump.
(4) Low pressure.	(a) Safety valve leaks. (b) Pump failure.	1. Replace valve. 2. Remove and replace.



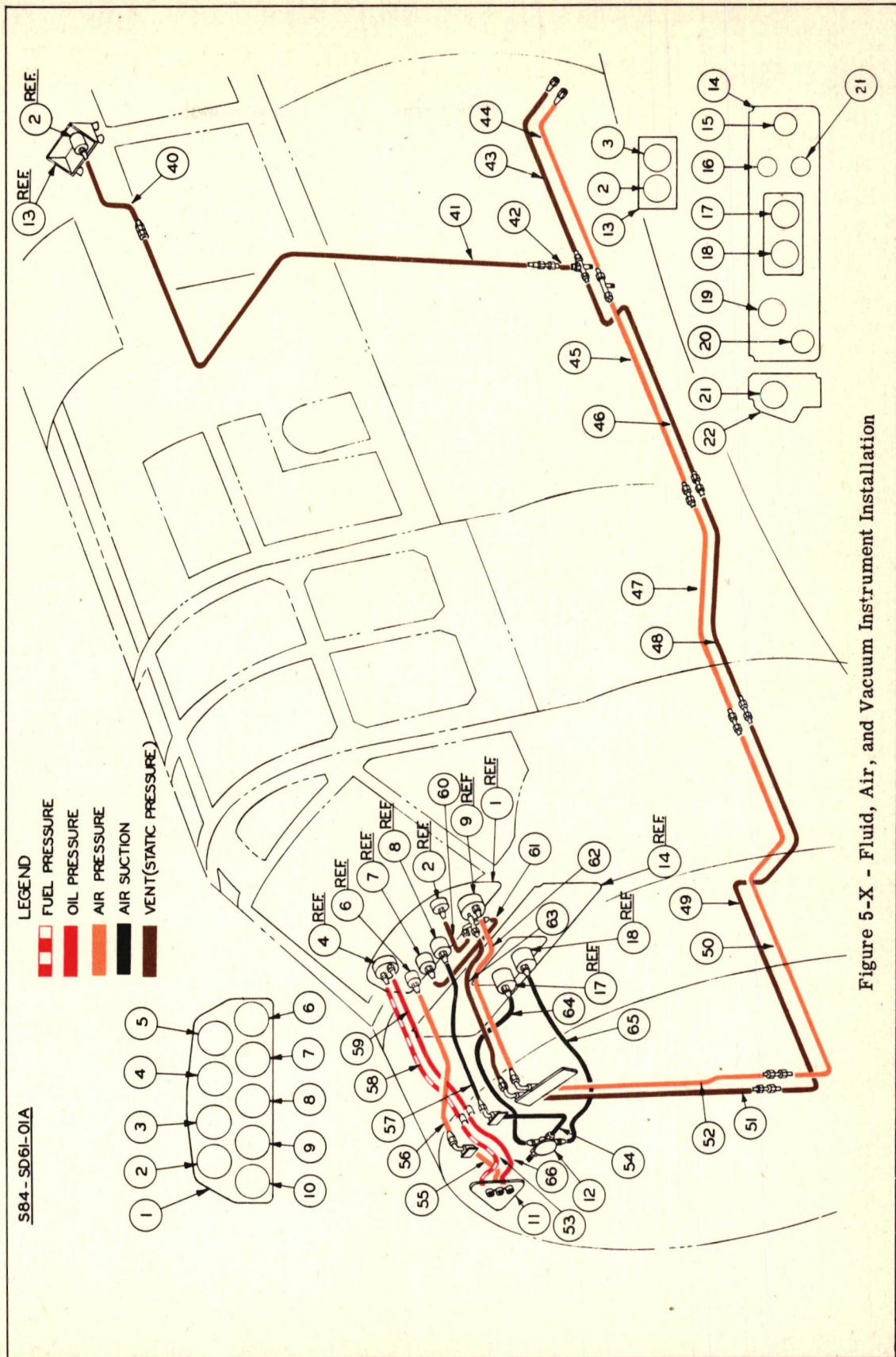


Figure 5-X - Fluid, Air, and Vacuum Instrument Installation

PARTS LIST - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1		Front Instrument Board - Upper (Ref.)	S84-61-592
2	2	Altimeter	FSSC-88A-340 *
3		Clock (Ref.)	FSSC-88C-570 *
4	1	Engine Gage Unit	FSSC-88U-316
5		Tachometer (Ref.)	FSSC-88I-2500
6	1	Manifold Pressure Gage	FSSC-88G-700
7	1	Rate of Climb Indicator	FSSC-88I-750
8	1	Turn and Bank Indicator	FSSC-88I-3280
9	1	Air-Speed Indicator	FSSC-88I-350 **
10		Remove Indicating Compass (Ref.)	AN5730
11		Fire Wall Connector (Ref.)	S84-SD44-02A
12		Suction Regulating Valve (Ref.)	S84-SD54-01A
13		Rear Cockpit Instrument Panel Assembly (Ref.)	S84-61-584 *
14		Front Instrument Board - Lower (Ref.)	S84-61-593
15		Thermocouple (Ref.)	FSSC-88I-2650
16	1	Carburetor Air Temperature Gage	Type C-11
17	1	Directional Gyro	AN5735-1
18	1	Gyro Horizon	AN5736-1
19		Fuel Gage (Ref.)	8DJ4PCS
20		Air Temperature Gage (Ref.)	FSSC-88I-2865
21		Hydraulic Pressure Gage (Ref.)	S84-SD33-19A
22		Check-Off Switch (Ref.)	FSSC-88S-1400 ***
23		Ignition Switch Panel (Ref.)	S84-61-514

* Rear cockpit instrument panel assembly and instruments on ships 41-18774 through 41-18783 only.

NOTES:

1. Drawing conforms to system installed on ships 41-18774 through 41-18793 only.
- ** Used on airplanes 41-18774 through 41-18783. For airplanes 41-18784 and up, see S84-61-08.
- *** Used on airplanes 41-18774 through 41-18777 only.

LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

Line Ref.No.	Part No.	Location	Size	Lgth.	End Fittings	Connector & Lines
40	AN855-4	Static Pressure Rear Cockpit Alti- meter to End Fit- ting - Line 41			Furnished on Flexible Hose	AN816-4D Altimeter to ** Line 40
41	S84-61-508-33	Static Pressure End Fitting, Line 40 to Upper Skin- Center Panel	1/4 OD-.035	69	AN818-4D AN818-4D	End Fit- tings on Lines 40 and 41
42	S84-61-509-12	Static Pressure Upper Skin-Cen- ter Panel to Cross AN827-4D	1/4 OD-.035	11	AN818-4D AN818-4D AN819-4 AN819-4	AN828-4D Line 41 to AN924-4 Line 42
43	S84-61-509-13	Static Pressure from Cross AN827- 4D to Rib S84-04- 531L	1/4 OD-.035	30	AN818-4D AN818-4D AN819-4 AN819-4	AN827-4D Line 43 to AN820-4 Line 42 & 46
44	S84-61-509-14	Pitot Pressure Rib S84-040-531L to Tee AN824-4D	1/4 OD-.035	28	AN818-4D AN818-4D AN819-4 AN819-4	AN824-4D Line 44 to AN820-4 Line 45
45	S84-61-509-6	Pitot Pressure Tee AN824-4D to Support S84- 33-897	1/4 OD-.035	31	AN818-4D AN818-4D AN819-4 AN819-4	AN828-4D Line 45 to AN924-4 Line 47
46	S84-61-509-8	Static Pressure Cross AN827-4D to Support S84- 33-897	1/4 OD-.035	30	AN818-4D AN818-4D AN819-4 AN819-4	AN828-4D Line 46 to AN924-4 Line 48

** Lines 40, 41, and 42 on ships 41-18774 through 41-18779 only.

<u>LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION</u>						
<u>Line Ref.No.</u>	<u>Part No.</u>	<u>Location</u>	<u>Size</u>	<u>LGth.</u>	<u>End Fittings</u>	<u>Connector & Lines</u>
47	S84-61-508-18	Pitot Pressure Support S84-33-897 to Bulkhead, Sta. 35.00	1/4 OD-.035	30	AN818-4D AN819-4	AN828-4D AN924-4 Line 47 to Line 50
48	S84-61-508-19	Static Pressure Support S84-33-897 to Bulkhead, Sta. 35.00	1/4 OD .035	30	AN818-4D AN819-4	AN828-4D AN924-4 Line 48 to Line 49
49	S84-61-508-4	Static Pressure from Bulkhead, Sta. 35.00 to Pilot's Floor near Sta. 0.00	1/4 OD-.035	50	AN818-4D AN819-4	AN828-4D AN924-4 Line 49 to Line 51
50	S84-61-508-3	Pitot Pressure from Bulkhead, Sta. 35.00 to Pilot's Floor near Sta. 0.00	1/4 OD-.035	50	AN818-4D AN819-4	AN828-4D AN924-4 Line 50 to Line 52
51	S84-61-507-7	Static Pressure from Pilot's Floor to Bracket S84-61-562 on Fire Wall	1/4 OD-.035	29	AN818-4D AN819-4	AN816-4D S82-61-358-1 to AN822-4D Line 51 to Line 63
52	S84-61-507-6	Pitot Pressure from Pilot's Floor to Bracket S84-61-562 on Fire Wall	1/4 OD-.035	28	AN818-4D AN819-4	AN816-4D S82-61-358-1 to AN822-4D Line 52 to Line 62
53	S84-61-507-904	Fuel Pressure on Fire Wall, from Connector S84-44-546 to Bracket S84-61-501-901	1/4 OD-.035	15	AN818-4D AN819-4	AN823-4D S82-61-358 to AN822-4D Line 53 to Line 58

LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Line Ref.No.</u>	<u>Part No.</u>	<u>Location</u>	<u>Size</u>	<u>Lgth.</u>	<u>End Fittings</u>	<u>Connector & Lines</u>
54	S84-61-507-2	Air Suction on Fire Wall from Suction Regulator Valve to Plate S84-61-561	1/4 OD-.035	9	AN818-4D AN818-4D AN819-4 AN819-4	AN822-4D Line 54 (2 Req.) to S82-61-358-1 Line 57
55	S84-61-507-8	Air Pressure on Fire Wall, from Connector S84-44- 546 to Bracket S84-61-547	1/4 OD-.035	6	AN818-4D AN818-4D AN819-4 AN819-4	AN823-4D Line 55 S82-61-358-1 to AN822-4D Line 56
56	AN856-4	Air Pressure From Bracket S84-61-547 to Manifold Pressure Gage			Furnished on Flexible Hose	AN816-4D Line 56 to Manifold Pressure Gage
57	AN856-4	Air Suction from Bracket S84-61-561 to Bank and Turn Indicator			Furnished on Flexible Hose	AN816-4D Line 57 to Turn & Bank Indicator
58	AN856-4	Fuel Pressure - Bracket S84-61-562 on Fire Wall to Engine Gage Unit			Furnished on Flexible Hose	AN816-4D Line 58 to Engine Gage
59	AN856-4	Oil Pressure from Bracket S84-61-562 to Engine Gage			Furnished on Flexible Hose	AN816-4D Line 59 to Engine Gage
60	S84-61-507-21	Static Pressure from Altimeter to Cross AN918-1D on Air-Speed Indicator	1/4 OD-.035	8	AN818-4D AN818-4D AN819-4 AN819-4	AN816-4D Line 60 to * Altimeter

LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Line Ref.No.</u>	<u>Part No.</u>	<u>Location</u>	<u>Size</u>	<u>Lgth.</u>	<u>End Fittings</u>	<u>Connector & Lines</u>
61	S84-61-507-22	Static Pressure from Rate of Climb Indicator to Cross AN918-1D on Air Speed	1/4 OD-.035	10	AN818-4D AN818-4D AN819-4 AN819-4	Line 61 to Rate of Climb Indicator *
62	AN856-4	Pitot Pressure Bracket S84-61-562 to Air-Speed Indicator			Furnished on Flexible Hose	AN816-4D Line 62 to Air-Speed Indicator
63	AN856-4	Static Pressure from Bracket S84-61-562 to Cross AN918-1D on Air Speed			Furnished on Flexible Hose	AN918-1D Line 63 to AN822-4D Lines 60 & (2 Req.) 61 and to AN816-4D Air Speed AN911-1D
64	AN856-6	Air Suction from Suction Regulator Valve to Directional Gyro			Furnished on Flexible Hose	AN822-6D Line 64 to Directional Gyro
65	AN856-6	Air Suction Section Regulator Valve to Gyro Horizon			Furnished on Flexible Hose	AN822-6D Line 65 to Gyro Horizon
66	S84-61-507-905	Oil Pressure Connector S84- 44-546 to Bracket S84-61-501-901	1/4 OD-.035	16	AN818-4D AN818-4D AN819-4 AN819-4	Line 66 S82-61-358-1 to AN822-4D Line 59

* Used on airplanes 4-18774 through 41-18783 only. Airplanes 41-18784 and up use S84-61-507-509 instead of S84-61-507-21 and S84-61-507-510 instead of S84-61-507-22.

RESTRICTED

Section X

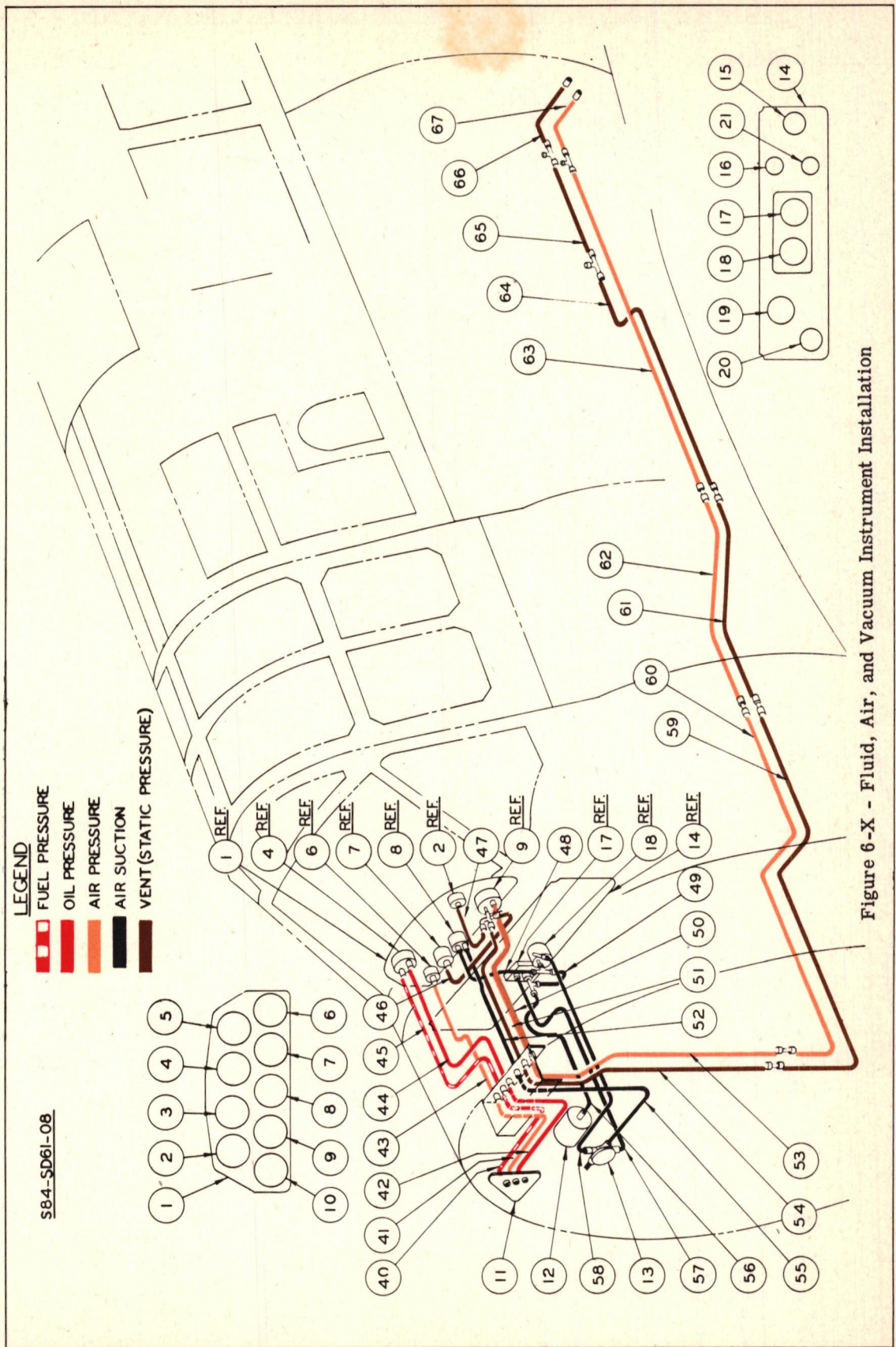


Figure 6-X - Fluid, Air, and Vacuum Instrument Installation

PARTS LIST - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1		Front Instrument Board (Ref.) (Upper)	S84-SD61-01A
2		Altimeter (Ref.)	S84-SD61-01A
3		Clock (Ref.)	S84-SD61-01A
4		Engine Gage Unit (Ref.)	S84-SD61-01A
5		Tachometer (Ref.)	S84-SD61-01A
6		Manifold Pressure Gage (Ref.)	S84-SD61-01A
7		Rate of Climb Indicator (Ref.)	S84-SD61-01A
8		Turn and Bank Indicator (Ref.)	S84-SD61-01A
9	1	Air-Speed Indicator	Type F2 AAF Spec. 94-27335-A
10		Remote Indicating Compass (Ref.)	S84-SD61-01A
11		Fire Wall Connector (Ref.)	S84-SD44-02A
12	1	Air Filter	AN5822-1
13		Suction Regulating Valve (Ref.)	S84-SD54-01A
14		Front Instrument Board (Ref.) (Lower)	S84-SD61-01A
15		Thermocouple (Ref.)	S84-SD61-01A
16		Carburetor Air Temperature Gage (Ref.)	AN5790-6
17		Directional Gyro (Ref.)	S84-SD61-01A
18		Gyro Horizon (Ref.)	S84-SD61-01A
19		Fuel Quantity Gage (Ref.)	S84-SD61-01A
20		Free Air Temperature Gage (Ref.)	S84-SD61-01A
21		Hydraulic Pressure Gage (Ref.)	S84-SD33-19A

NOTE:

1. Effective on Airplane No. 41-18784 and up.

LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
40	S84-61-507-504	1	Fuel Pressure from Fire Wall Connector S84-44-546 to Bracket S84-61-562	1/4 x .035	31.00	Alum. A1.52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
41	S84-61-507-508	1	Air Pressure from Fire Wall Connector S84-44-546 to Bracket S84-61-562	1/4 x .035	20.00		
42	S84-61-507-505	1	Oil Pressure from Fire Wall Connector S84-44-546 to Bracket S84-61-562	1/4 x .035	15.00		
43	AN856-4	1	Air Pressure from Bracket S84-61-562 to Manifold Pressure Gage				Furnished on Flexible Hose
44	AN856-4	1	Oil Pressure from Bracket S84-61-562 to Engine Gage Unit				Furnished on Flexible Hose
45	AN856-4	1	Fuel Pressure from Bracket S84-61-562 to Engine Gage Unit				Furnished on Flexible Hose
46	S84-61-507-510	1	Static Pressure from Air-Speed Indicator to Rate of Climb Indicator	1/4 x .035	11.00		
47	S84-61-507-509	1	Static Pressure from Altimeter to Air-Speed Indicator	1/4 x .035	9.00		

LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
48	AN856-4	1	Air Suction from Bank and Turn Indicator to Gyro Horizon				Furnished on Flexible Hose
49	AN856-6	1	Air Suction from Gyro Horizon to Directional Gyro				Furnished on Flexible Hose
50	AN856-4	1	Pitot Pressure from Air-Speed Indicator to Bracket S84-61-562				Furnished on Flexible Hose
51	AN856-4	1	Static Pressure from Air-Speed Indicator to Bracket S84-61-562				Furnished on Flexible Hose
52	AN856-4	1	Air Suction Line from Turn and Bank Indicator to Bracket S84-61-562				Furnished on Flexible Hose
53	S84-61-507-506	1	Pitot Pressure from Bracket S84-61-562 to Pilot's Floor	1/4 x .035	30.00	Alum. A1.52SO WW-T-787	AN818-4D AN818-4D AN819-4 AN819-4
54	S84-61-507-507	1	Static Pressure from Bracket S84-61-562 to Pilot's Floor	1/4 x .035	31.00		
55	S84-61-507-502	1	Air Suction from Bracket S84-61-562 to Suction Regulating Valve	1/4 x .035	11.00		
56	AN856-8	1	Air Suction from Air Filter to Directional Gyro				Furnished on Flexible Hose

LINE ASSEMBLIES - FLUID, AIR, AND VACUUM INSTRUMENT INSTALLATION

<u>Line</u> <u>Ref.No.</u>	<u>Part No.</u>	<u>Location</u>	<u>Size</u>	<u>Lgth.</u>	<u>End Fittings</u>	<u>Connector & Lines</u>
57	AN856-6	1 Air Suction from Directional Gyro to Suction Regulating Valve				Furnished on Flexible Hose
58	AN856-6	1 Air Suction from Horizon to Suction Regulating Valve				Furnished on Flexible Hose
59	S84-61-508-4	1 Static Pressure from Pilot's Floor to Sta. 35.00	1/4 x .035	50.00		
60	S84-61-508-3	1 Pitot Pressure from Pilot's Floor to Sta. 35.00	1/4 x .035	50.00		
61	S84-61-508-19	1 Static Pressure from Sta. 35.00 to Support S84-33-1018	1/4 x .035	30.00		
62	S84-61-508-18	1 Pitot Pressure from Sta. 35.00 to Support S84-33-1018	1/4 x .035	30.00		
63	S84-61-509-526	1 Pitot Pressure from Support S84-33-1018 to Tee	1/4 x .035	6.75		
64	S84-61-509-523	1 Static Pressure from Support S84-33-1018 to Tee	1/4 x .035	9.00		
65	S84-61-509-522	1 Static Pressure from Tee to Tee	1/4 x .035	3.00		
66	S84-61-509-507	1 Static Pressure from Tee to Rib on Trailing Assembly	1/4 x .035	9.25		
67	S84-61-509-511	1 Pitot Pressure from Tee to Rib on Trailing Assembly	1/4 x .035	10.00		

Section XI

ELECTRICAL SYSTEM

1. General.

The electrical system of the airplane is basically a twenty-four volt, direct current, single wire conductor system. However, a few units of the system employ a ground wire return. All circuits are protected by breakers. Master switch boxes are used to control a group of units. The master switch must be "ON" to control equipment through other switches. The complete system is made up of several sub-systems, which will be discussed individually.

2. Primary Power System.

The primary power system is a source of electrical current for the entire electrical system of the airplane and involves the use of the batteries, generator, voltage regulator, reverse current relay, and master switches as its major units. An external power plug is provided for the use of a battery cart.

a. Batteries.-

(1) Description.- Airplanes No. 41-18774 through 41-18873 and 42-79663 through 42-79732.

(a) Reserve power is supplied by two NAF-1062-19 12-volt batteries in series, located aft of the fire wall on the right-hand side of the airplane beneath the front cockpit floor. The batteries are accessible through the target approach doors.

(b) Removal.- To remove batteries, disconnect the power leads at the battery and remove the two wing nuts and hold-down plate on each battery.

(c) Description.-

1. Airplanes No. 42-79733 and up are equipped with an AN3150 battery, rated at 24-volts - 34 ampere hours. The battery is located forward of the bomb bay on the center line of the airplane under the cockpit floor.

A sump and vent system consisting of a 6115-F jar equipped with felt and a series of tubes is used to prevent the collection of gases and to neutralize gases in the battery case.

Access to the battery installation is provided through a door on the bottom of the fuselage aft of the fire wall. The door is hinged to open outward and is secured, when closed, by seven "shake-proof" type fasteners.

(2) Removal.- To remove the battery, the following procedure is recommended:

- (a) Remove the two wing nuts from the battery terminal cover and remove cover.
- (b) Remove battery leads from battery terminals
- (c) Remove the vent tubes at the battery, by unfastening the lock wires and tube clamps.
- (d) Remove the lock wires and the battery hold-down wing nuts.
- (e) Lift battery up and forward to clear channel.

The sump is located in such a position that it cannot be serviced when the battery is in the airplane.

To remove the jar of the sump, unscrew the clamp securing the jar and remove the jar.

CAUTION: Avoid spilling electrolyte on the airplane skin or structure. If spilled, wash parts as soon as possible with ammonia to neutralize acid, then flood with water. Do not allow the ammonia to get into the battery.

(3) **Maintenance.**- Maintenance of the batteries will consist of cleaning and testing the electrolyte level. The battery will be charged if necessary.

NOTE: The battery should be removed from the airplane before servicing.

(a) **Cleaning.**- When cleaning a battery, use a brush and a solution of ammonium hydroxide or sodium bicarbonate. Make sure all corrosion and moisture retaining dirt is removed. Dry battery thoroughly, using a compressed air hose if possible. Exercise precautions against blowing liquid on any part of airplane or mechanic's person.

(b) **Electrolyte Level.**- The level of the electrolyte battery cell must not be allowed to get below the top of the plates, as the capacity of the battery will be correspondingly reduced; also the lead sulphate on the plate area above the electrolyte will crystalize. If too much liquid is placed in the cells, leakage will result when the airplane is not in level flight.

(c) **Testing.**- When testing a battery, two tests are necessary - specific gravity and cell voltage. To test specific gravity of a battery, a hydrometer must be used. A hydrometer reading of 1.280 to 1.300 indicates a fully charged battery.

If the specific gravity is below 1.200 and all cells approximately equal, a normal state of discharge exists and the battery must be recharged or replaced with a serviceable unit. Voltage reading should be two volts per cell.

NOTE: A state of discharge in a battery may be due to the conditions in the battery itself, such as, sulphation, cracked cells, shorted or buckled plates, etc., which would prevent the battery from taking or holding a charge.

(d) **Charging.**- A battery can be charged only with direct current. If only alternating current is available, it will be necessary to use a motor-generator set or a rectifying device to furnish the required direct current. For details in the use of these two methods, refer to T. O. No. 03-5B-1.

Batteries of different ampere-hour capacities will not be charged in the same circuit if a constant current charging system is used.

In connecting batteries to the charging equipment, like terminals of the battery and charging equipment must always be connected together (positive to positive and negative to negative).

Batteries undergoing charge should be inspected at intervals of from one-half to one hour, and a temperature and gravity reading taken of one cell of each battery. The temperature of the battery, obtained by a thermometer reading of the electrolyte should never exceed 110 degrees F (43 degrees C) and should be kept below that point by reducing the charging rate if necessary. Also when excessive gassing is noted, the current should be reduced. Batteries should remain on charge until the specific gravity approaches normal (1.280 to 1.300) providing the electrolyte has not been diluted during service, and three successive 30-minute interval inspections reveal no increase in the gravity reading.

(e) **Troubles and Remedies.**-

1. Electrolyte consistently low. This condition may be caused by:

- a. Abnormal operating temperature.
- b. Improper sealing of vent plugs.
- c. Lack of proper maintenance; failure to replace evaporated water.
- d. Cracked or leaking containers.

e. Charging rate too high.

2. Freezing may be caused by:

- a. Exposure to extreme low temperatures when not in use.
- b. Specific gravity too low (state of discharge).

A frozen battery may be saved, if the freezing has not progressed to the point that breakage occurs, by placing it in a room of normal temperature and allowing it to thaw slowly. Where low temperatures are to be encountered, batteries must be kept in a full state of charge. If water is added in freezing weather and not immediately mixed with the solution by charging, the water will remain on top of the electrolyte and freeze at a much higher temperature than the freezing point of the electrolyte.

3. Loss of Capacity.- Failure of a battery to deliver its rated energy for the proper length of time, and a rapid decrease in specific gravity of the electrolyte after a charge may be due to any of the following:

- a. Loss of electrolyte.
- b. Low operating temperatures.
- c. Overcharging for long periods.
- d. Internal or external short circuits.

e. Sulphation of Plates.- Excessive sulphation is usually caused by allowing a battery to stand idle in a discharged condition for too long a time or by repeated undercharging.

f. Battery in service too long.

g. Tests Before Installation.- Before the battery is installed in the airplane, test the gravity to determine if a full state of charge exists. Examine the terminal posts for looseness and corrosion. Check carefully for cracks in the case. The battery carrier should be examined for corrosive condition and the condition of the hold-down device. Make certain that the battery cable terminals are free of corrosion and tight on the cable. It is advisable to check the cables for a worn or frayed condition of the insulation especially where they may come in contact with metal parts of the airplane.

4. Installation.- The batteries are installed through the target approach doors or access door. When installing batteries that are equipped with terminals threaded for the use of wing nuts, the battery leads will be secured by using one plain and one lock washer as follows:

a. First place the battery lead terminal over the battery post; then install one lock washer and one plain washer, in the order named, and securely tighten the wing nut. The lock washer is not placed at the top (next to the wing nut) for the reason that the protruding ends scrape the lead coating from the nut, hastening corrosion. Although the washers are not lead-coated, they are inexpensive and can be replaced frequently if corroded. In no case will battery wing nuts be drilled and locked with safety wire. Terminals should be given a thin smooth coating of vasoline (or equivalent) to prevent corrosion.

b. Place hold-down plates in place, making sure that washers are on top of hold-down plate, and make secure by tightening wing nuts.

5. External Power.- An external power plug is provided for auxiliary or emergency use. The plug is located either on the aft side of the fire wall, directly under the left upper inspection plate, or in the right wheel well recess next to the up-latch.

For further information on storage batteries, refer to T. O. No. 03-5B-1.

NOTE: When an external source of power is available, and can be attached to the airplane, such equipment must be used for starting and testing purposes.

b. Generator.-

(1) Description.- The generator is of the engine-driven dc type. It is air cooled through the use of a blast tube. Electrical receptacles are provided on the generator for connections. A number of holes are provided in the mounting flange permitting rotation until best mounting position is obtained. The purpose of the generator is to supply current for operation of electrical accessories and maintaining the battery in a state of charge.

(2) Maintenance.- Under normal conditions, the generator requires very little attention with the exception of periodical checks and removal for overhaul.

(a) After initial installation on the engine, the generator should receive careful surface inspection at ten-hour intervals for the first fifty hours of operation. After that period, it should receive a surface inspection at every general engine inspection and wash-down. The purpose of these checks is to detect possible defects in mounting flange, castings, and connections.

(b) At every general engine inspection, examine the brushes to see that they move freely in their holders. Replace the brushes if they are excessively worn. Check the brushes for dirt or oil and clean if necessary. The brush holders and rigging should be checked for looseness. Check the brush springs for proper tension.

Inspect the commutator to see that the edges of the bars are not blackened. The commutator should have an even brown copper color. Check the commutator for the presence of oil. If oil is found on the commutator, clean commutator and replace brushes. Oily brushes cause voltage drop, increased heat, and decreased output.

A dirty or rough commutator may be cleaned with No. 000 (or finer) sandpaper; however if it is extremely rough, burned, or pitted, the generator must be removed and replaced or repaired.

Check all internal connections for security.

(3) Removal.- If it becomes necessary to remove the generator from the engine, disconnect the electrical junction plug at the generator. Remove the air blast cover from the generator, or remove the air blast tube from the cover. The procedure involved is self-evident. A special wrench is required to remove the generator.

Be sure to support the generator as the screws are being removed.

(4) Tests.- The armature may be tested for shorts, grounds, and open circuits with the armature removed from the generator by following the procedure given below.

(a) Ground.- To test for grounds, use an ohmmeter or other type of continuity tester. Check the resistance between each commutator segment and the shaft by placing one lead of the instrument on the segment to be tested and the other on the armature shaft.

(b) Short.- Apply battery voltage to two commutator segments directly opposite each other. Use an ohmmeter and place the two leads on adjacent segments. Zero resistance indicates a short.

(c) Open Circuit.- To test for open circuit, hook up ohmmeter as above. A high resistance reading indicates open circuit. A "growler" may be used for testing when available.

(d) Trouble Shooting.- The following is a list of possible generator troubles, their possible causes, and remedies.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
1. No voltage output.	a. Burned out winding.	(1) Replace unit.
	b. Worn out brushes.	(1) Replace brushes.
	c. Shorted field circuit.	(1) Replace field windings.
	d. Open field circuit.	(1) Repair or replace.
	e. Loose brush leads.	(1) Clean and tighten.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
2. Low output.	a. Insufficient brush pressure. (1) Inspect and replace springs if necessary.	
	b. Improper brush fit. (1) Use sandpaper to fit brushes.	
	c. Worn brushes. (1) Replace.	
	d. Dirty commutator. (1) Clean commutator.	
	e. Rough or worn commutator. (1) Turn commutator or replace armature.	
3. Overheating.	a. Sustained overload. (1) Check for dead shorts, etc., and correct.	
	b. Poor air circulation. (1) Inspect ventilating system.	
	c. Shorted armature. (1) Replace armature.	

c. Voltage Regulator. -

(1) Description. - The purpose of the voltage regulator is to maintain the voltage of the electrical system constant, regardless of variations in the speed of the generator and conditions of varying electrical loads. Constant voltage is necessary for most of the electrically operated equipment on the airplanes and to keep the battery charged. Voltage regulation is accomplished automatically by controlling the amount of resistance inserted into the field circuit of the generator.

NOTE: The voltage regulator is a precision unit and will not withstand rough treatment. Avoid dropping or sudden shock.

(2) Maintenance. - Whenever the regulator fails to function correctly, the following checks or adjustments should be made.

(a) Check pivot springs. Spring clamps should be straight and springs should lie flat and aligned with one another; bent springs or clamps should be replaced.

(b) Check contact points for burned, pitted, or dirty condition. If dirty, clean with a piece of paper drawn between the points; otherwise replace unit.

(c) Check voltage at bus. It should be not over 28.5 volts. This can be adjusted by increasing the spring tension of the point springs to decrease the voltage or decreasing the spring tension to increase the voltage. An adjustment nut is provided for this purpose. The engine should be run about 1800 rpm.

(d) Check regulator for security of mountings and condition of shock pads.

(e) Check all internal and external connections.

NOTE: High voltage can be caused only by a defective regulator or a regulator not correctly adjusted, not by the generator. A generator condition will give either low voltage or no voltage.

d. Reverse Current Relay (cut-out). - The relay switch connects the generator to the electrical system when the generator voltage is sufficiently high. The relay will close only when the "generator" switch on the main switch panel is closed. Whenever the generator voltage becomes lower than the system voltage, the relay automatically opens to prevent the flow of current from the battery to the generator.

The relay closing voltage should be between 26 and 27 volts. This can be adjusted by turning the screw located in the spring clip immediately above the name plate.

Refer to T. O. No. 03-5-39.

3. Main Switch Box.

a. Description.- The main switch box is located on the right side of the pilot's cockpit. Current is supplied from the battery to the fire wall junction box, to the main switch box which controls the current to the following units:

- (1) Starter
- (2) Emergency fuel pump
- (3) Primer pump
- (4) Booster pump
- (5) Oil dilution system
- (6) Fuel gages and howler
- (7) Anti-icer system
- (8) Pitot heater
- (9) Formation lights
- (10) Recognition lights
- (11) Section lights
- (12) Running lights
- (13) Landing lights
- (14) Cockpit lights
- (15) Remote indicating compass
- (16) Wing gun heaters

Most circuits are protected by breakers which are normally "ON."

b. Removal.- If it is necessary to remove the entire main switch box from the airplane, the following procedure is recommended.

(1) Remove intercommunication switch box and radio destroyer switch from the right-hand side of the main switch box.

(2) Remove the two screws which secure the main switch box to the supporting brackets at each side.

(3) Draw the box forward in a tilted position and disconnect the junction plug from the bottom of the main switch box.

c. Disassembly.- All switches may be removed by using a socket wrench and removing the nuts from the studs. Rheostats may be removed in the same manner, after first removing the knobs on the outer side of the panel.

d. Inspection.- The panel of the main switch box is hinged, for conveniently inspecting it. It is secured to the box frame by four screws, two of which are located in the upper corners of the panel, one next to the anti-icer control, and the other next to the starter switch.

4. Starter.

The engine is equipped with a Jack and Heintz electric "inertia type" starter model No. JH-5F. This unit is mounted in the engine accessory section and is controlled by a switch mounted on the main switch box panel. Current is supplied from the battery or through external power source. The "START" position of the switch energizes the starter and flywheel. The "MESH" position of the switch is used to start the engine. When the "MESH" position is used, the booster coil circuit is closed and the brush operating solenoid eliminates the drag on the starter caused by the rubbing of the brushes. The brushes do not contact the commutator unless the solenoid is energized by placing the starter switch in "START" position. A relay is placed in the starter circuit between the switch and the starter.

a. Maintenance and Repair.- At the fifty-hour check of the engine, remove the top cover and remove the brush rigging. Inspect for loose connections. Clean and tighten where necessary. Replace all defective wiring. Examine brush holders for free movement. Use very little light oil on brush pivots. Replace brushes if exposed length beyond holder is less than 3/32-inch.

Examine the commutator. If it is smooth, leave it alone. If rough and pitted, use commutator honing kit No. 870 by following instructions on inside of cover of carrying case.

At major engine overhaul or engine change, the starter and accessories should be removed and forwarded to the depot for overhaul.

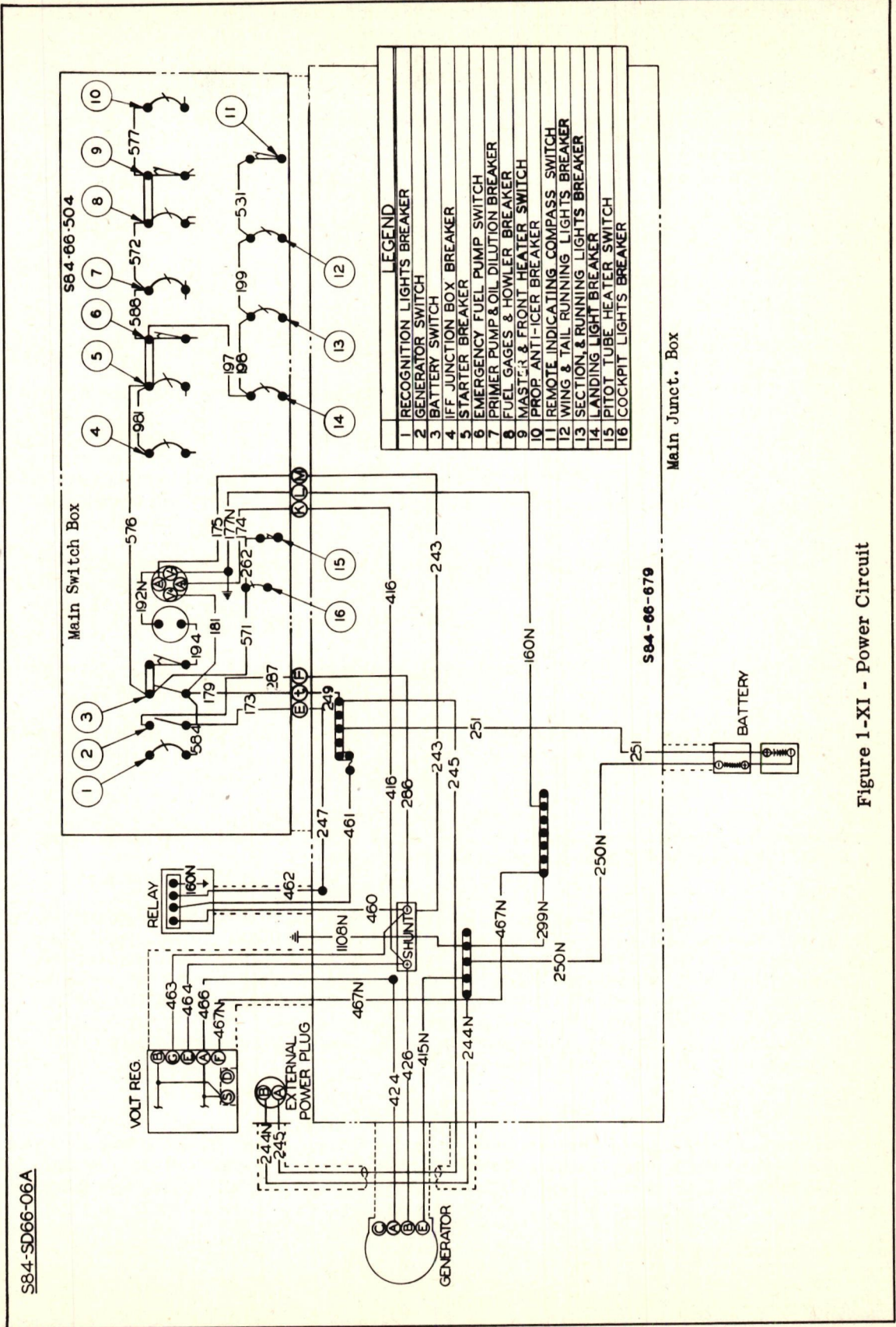


Figure 1-XI - Power Circuit

b. Service Troubles and Remedies.- The following information lists starter troubles, which may be caused by electrical malfunction, and their possible causes and remedies.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
(1) Motor fails to operate.	(a) Wiring not properly connected.	1. See wiring diagram.
	(b) Loose and high resistance connections.	1. Clean and tighten.
	(c) Brush-engaging solenoid not working.	1. Remove brush rigging and test.
	(d) Loose or corroded battery terminals.	1. Clean and tighten.
	(e) Brush holder binding.	1. Remove pivot pins and clean.
	(f) Worn brushes.	1. Replace.
	(g) Dirty commutator.	1. Clean.
	(h) Rough or pitted commutator.	1. Disassemble and smooth. (See NOTE)
	(i) Shorted, grounded, or open armature.	1. Replace. (See NOTE)
	(j) Starting switch inoperative.	1. Disassemble, clean, or replace as necessary.
	(k) Motor jammed.	1. Disassemble and check mechanical parts of starting unit. (See NOTE)
	(l) Defective relay.	1. Check with jumper across heavy terminals. Replace or repair as necessary.
(2) Excessive arcing at motor brushes.	(a) Armature shorted or open.	1. Test and replace. (See NOTE below.)
(3) Booster coil inoperative.	(a) Improper wiring.	1. Check wiring diagram.
	(b) Defective coil.	1. See T. O. No. 03-5-9.
	(c) Defective contact at switch.	1. Check and correct or replace if necessary.
(4) Solenoid-meshing device fails to engage starter.	(a) Improper electrical connections.	1. See wiring diagram.
	(b) Coil open.	1. Test and replace.

NOTE: Starters will be considered class two reparable property, by all activities, other than air depots having major repair departments, and no activity, other than engineering departments of air depots, may perform any repairs on such starters other than exterior cleaning, replacement of brushes or brush rigging, jaw meshing solenoids, jaw, hand-crank adapters, complete starters, plugs, connecting cables, and wires. When the starters of any type require any other repairs, they shall be forwarded to the air depot from which supplies are regularly received, where necessary repairs will be accomplished.

5. Emergency Fuel Pump.

The airplane is equipped with an electric motor-driven Pesco 2E-608A (old No. 542-D) emergency fuel pump using electric motor No. 542-1B. It is located on the left side of the fuselage between the fire wall and the bulkhead at station 30 and is accessible through the target approach doors. Current is supplied through a switch on the main switch panel.

a. Inspection and Maintenance.-

(1) 100-Hour.- Remove and inspect brushes for wear and free movement in the brush holders.

(2) Regular inspection should be made, the frequency depending on the time and type of service. This can be determined by observation but do not neglect the motor during any inspection of equipment. At this time, all connections should be cleaned and tightened and any damaged wires replaced. Check all the wires and tighten if necessary. Examine the brushes and replace if worn to 3/8 inch or less. Wipe out the brush holders with a clean cloth and, if the brushes are not replaced, clean these also. If greasy, use small amount of unleaded gasoline on the cloth. Check the springs; if they are annealed, discard the brush assembly and check for cause.

It is advisable to check the commutation. This can be done by removing the breather plug and running the motor. If excessive sparking is evident, and is not due to installation of new brushes, the motor should be removed and set to depot for overhaul.

b. Replacement.

(1) Motor. - The motor is attached to the pump by four studs in the end of the gear housing. (Remove the four stud nuts after first removing the safety wire.) Remove the electrical connection by unscrewing the knurled sleeve at the motor receptacle. The four nuts on the motor base bracket secure the motor to the fuselage and must be removed. The motor and gear case assembly can then be lifted straight up until the splined shaft is clear of the pump unit. Install in reverse order, making sure splined shaft is seated properly before tightening stud nuts.

(2) Brushes. - The motor must be removed before the brushes can be replaced.

(a) The brush holder screw assembly is held in place by a screw, which is removed to free the brush holder. The brush holder screw is then removed slowly, followed by the brush and spring assembly.

(b) When replacing brushes, be sure brush holders are lined up so that the long side of the brushes is parallel to the armature shaft. Clean brush holders thoroughly and see that brushes move freely. When replacing the inner brush holder screw, prevent the brush cap from turning by holding it in place with a pointed instrument while tightening screw which is open on top. This is done to prevent the spring and shunt from turning or twisting. The external brush holder screw has a fibre washer to prevent the brush holder from grounding if the inner screw becomes loose. Be sure this washer is in place.

(3) Test. - After assembly, make certain motor will start freely on 20 volts dc, check for ground after motor is warmed up and check performance on 24 volts dc; no-load speed should be approximately 3600 rpm at 3.5 amperes.

For further information, refer to T. O. No. 03-5CA-13.

6. Priming System.

The primer is incorporated in the carburetor. It consists of a solenoid operated needle valve, controlled by a "momentary" type switch on the main switch box. The unit is located at the fuel inlet connection of the carburetor.

Closing the primer circuit energizes the solenoid and magnetizes the soft steel core. This magnet draws the needle valve off its seat, bypassing fuel from the main fuel line through the primer to the engine priming system.

a. Removal. - The solenoid unit may be removed from the valve assembly by the following procedure:

(1) Remove electrical connection from cap. This is a quick-disconnect type junction plug.

(2) Remove the safety wire and the four fillister-head screws attaching solenoid assembly to valve assembly.

(3) Solenoid can then be removed as a unit.

b. Disassembly. - To disassemble the solenoid unit:

(1) Remove the screws securing the primer cap to the solenoid cover assembly and remove cap assembly.

(2) Unscrew the brass nuts and remove solenoid cover assembly.

(3) Remove brass solenoid separator and gasket. The needle and spring assembly may then be removed.

c. Reassembly.-

(1) Install needle into seat of inlet casting.

(2) Install spring in retaining well of needle.

(3) Place air gap shim and compression gasket over terminals.

(4) Place gasket on inlet casting and place brass separator on top of gasket.

(5) Set solenoid cover assembly over solenoid and install brass elastic nuts. (Refer to item (h) for correct use of washers.)

(6) Set assembly from item (e) on brass separator so the name plate will be plainly visible and the terminal cap electrical outlet will point in the desired direction.

(7) Install the four retaining screws and secure with safety wire.

(8) Install the washer and terminal post nut on terminal that will direct plug opening in desired direction. Install nut on other post without a washer, as this is the ground.

(9) Press cap assembly over terminal and install screws and safety wire.

(10) Install electrical connection.

d. Test primer by applying required voltage across the terminals.

NOTE: This should not be done in conjunction with test-stand tests.

e. Maintenance Repair.- Since the solenoid is of a simple coil construction, the maintenance service is very limited. The following table includes possible troubles, causes, and remedies:

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
(1) Primer fails to open.	(a) Defective solenoid.	1. Replace.
	(b) Wrong voltage across terminals. (Voltage is stamped on core of solenoid.)	1. Replace with proper solenoid.
	(c) Poor electrical connections.	1. Clean and tighten.
	(d) Binding condition between needle and seat.	1. Check and correct.
	(e) Extra gasket between primer cover assembly and inlet casting.	1. Install one gasket only.
	(f) Improperly made electrical connections.	1. Check and use proper connection for type of cap used.
(2) Sluggish action of primer.	(a) Binding condition between needle and needle seat.	1. Check and correct.

For further information refer to T. O. No. 03-10BC-2.

7. Booster Pump.

A Thompson TFD-8000 booster pump is located at the sump directly under the forward end of the fuselage tank. It is used to increase the flow of fuel during take-off and high altitude operation. It is controlled by a switch and rheostat located immediately to the left of the pilot's seat. Listed below are various troubles, which may be caused by the electrical portion of the pump, and their possible causes and checking procedure or remedies.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
a. Low discharge pressure.	(1) Loose or high resistance in connections. (2) Low voltage. (3) Brushes not properly seated after reassembly or replacement. (4) Worn brushes. (5) Brushes binding in brush holders. (6) Improper wiring. (7) Gasoline in motor. (8) Dirty and rough commutator. (9) Shorts, grounds, open commutator or field circuits, or insulated brush holders.	(a) Clean and tighten. (a) Check voltage across pump motor terminals. (a) Run pump under load for two hours. (a) Replace. (a) Remove and clean. (a) Check with wiring diagrams. (a) Remove and check seals. (a) Clean and repair. (a) Test. Replace if defective.
b. Excessive current demand.	(1) Brushes not seated after reassembly or replacement. (2) Bearings worn or lubricant washed out. (3) Commutator out of round. (4) Improper lubricant for low temperatures. (5) Short in armature.	(a) See No. 3 above. (a) Check and replace if necessary. (a) Repair. (a) Replace. (a) Replace.
c. Pressure surges.	(1) Variation in voltage source. (2) Loose connections. (3) Gasoline in motor.	(a) Check generator and voltage regulator. (a) Clean and tighten. (a) Remove and check seals.
d. Pump fails to operate.	(1) Wiring not properly connected. (2) Loose or high resistance in connections. (3) Gasoline in motor. (4) Dirty brushes and commutator. (5) Rough commutator. (6) Shorted, grounded, or open field or commutator. (7) Brushes binding. (8) Grounded insulated brush holders.	(a) Check wiring diagrams. (a) Clean and tighten. (a) Remove and check seals. (a) Remove, clean, and smooth. (a) Repair. (a) Replace if defective. (a) Remove and clean. (a) Replace if defective.

Refer to T. O. Nos. 03-10EC-2, 03-10EC-3, 03-10EC-4, 03-10EC-5 and section XVI.

For further operation and maintenance information on this pump, refer to section XVI in this book.

8. Oil Dilution System.

a. Description.- The oil dilution is used to facilitate starting a cold engine. A switch on the main switch box controls the operation of a solenoid valve which requires a minimum of nine volts current. A valve AC-37D6210 opens a line from the carburetor intake line to the "oil in" line, which permits fuel to enter the oil system. It is attached to the upper left engine support, just below the booster coil, by a clamp.

T. O. No. 03-15-11 approves Air Associates Inc. valve M-441-M2 as a substitute for AC valve No. 37D6210.

Two manual controlled cocks are provided to prevent the flow of fuel when dilution is not desired.

b. Inspection.- All airplanes equipped with oil dilution valve solenoid will have this valve inspected at each 25-hour inspection period in accordance with the following instructions:

- (1) Remove all necessary cowling.
- (2) Remove the plug which fits in the end of the solenoid valve.
- (3) Start the engine.
- (4) If gasoline leakage through the bottom of valve is over ten drops a minute, stop the engine. Install plug. Start engine and turn oil dilution "ON" and "OFF" for 10 five-second periods. Stop engine, remove plug, and recheck for leakage. If excessive leakage persists:
Push valve plunger several times and let it spring back. If this does not stop leaking condition, remove the valve assembly and replace with new unit.

For additional information on oil dilution system, refer to T. O. No. 03-15-3 and section XVI.

9. Howler.

The howler is located behind the pilot in the turn-over structure and is used to warn the pilot when the landing gear is not locked down for landing. Current for the circuit is supplied through the main switch panel and is controlled by the switch marked "Fuel Gage and Howler." With the throttle less than one-fourth open, the howler will operate if either of the landing wheels or tail wheel is not in a locked "DOWN" position.

Micro-switches are installed at each of the landing gear and tail wheel lock-down mechanism to control that particular signal circuit. The landing gear switches are easily accessible through the landing gear wells in the wings. The tail wheel switch can be reached through the inspection plate on the right-hand side of the fuselage.

a. Inspection and Tests.- Due to the simplicity of the parts and circuits involved, only routine inspection both visual and operative are necessary. Proceed as follows:

- (1) Close "Howler" switch on main switch panel, and set throttle less than one-fourth open.
- (2) Use a jumper across micro-switch terminals. Howler should sound. If not, check for open circuit with light or buzzer.
- (3) Check switch plungers for binding condition.
- (4) Check security of mounting of all units.
- (5) Check all electrical connections.

b. Maintenance Repair.- The following table lists some of the possible service troubles, causes, and remedies.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Signal fails to operate.	(a) Low battery voltage.	1. Replace battery or charge.
	(b) Loose or corroded battery terminals.	1. Check and tighten.
	(c) Incorrect wiring.	1. Check wiring diagram.
	(d) Loose or high resistance in connection.	1. Clean and tighten.
	(e) Shorted field coil.	1. Test and replace.
	(f) Broken contact spring.	1. Replace contact spring and adjust air gap .028 inch to .030 inch.
	(g) Broken or unsoldered internal connection.	1. Check and repair.
	(h) Defective micro-switches.	1. Check and replace defective unit.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(2) Low sound intensity.	(a) Low battery voltage. (b) Defective condenser. (c) Broken armature spring. (d) Broken diaphragm.	1. See (a) above. I. Replace. I. Replace (see (f) above). I. Replace.
(3) Excessive arcing at contacts.	(a) Improper adjustment. (b) Defective condenser. (c) Broken armature spring.	1. Readjust. I. Replace. I. Replace and adjust air gap.

NOTE: Howler should be removed from airplane for service.

c. Removal.- The howler is removed from the airplane by removing the four nuts and bolts securing it to the bracket on the turn-over structure, and disconnecting the electrical connection at the howler.

The case is removed by removing the screw in the center of the case, opposite the open side of the howler.

d. Adjustment.- To adjust the tone of the howler, it is best to remove it from the airplane. The following procedure should be followed:

- (1) Remove the case.
- (2) Connect howler to a fully charged battery.
- (3) Loosen the lock nut and turn the nut immediately under it until desired tone is obtained. The lock nut and adjusting nut are located directly under the case attaching screw bracket.
- (4) Tighten the lock nut and recheck tone.

Refer to T. O. No. 03-5-11.

10. Fuel Indicators and Transmitters.

The airplane is equipped with a fuel level indicator gage and transmitter for each of the fuel tanks. Each transmitter and indicator makes up a unit for their specific fuel tank, and are controlled by the switch on the main switch panel marked "Fuel Gages and Howler."

The indicators 8DJ4PCS are grouped on the instrument panel and are of the magnet-type.

The transmitter is of the rheostat-type actuated by a float and gear arrangement incased as a unit in each individual fuel tank. The wing tanks use transmitter 8TJ13LKD41. Transmitter 8TJ13LEY41 is used in the fuselage tank.

a. Maintenance.-

(1) Indicator.- Check the indicator for lag or sluggish operation by turning on the battery and fuel gage switches and noting the action of the pointers. There should be no indication of lag or stickiness. When the switches are turned off, the pointers should be pulled off scale. If any sign of lag or stickiness is noticed, remove and replace unit.

If the glass is broken, replace with new glass, making sure no particles of glass remain in instrument.

If glass is loose, add a thicker gasket under the glass.

(2) Transmitter.- Remove the transmitter from the fuel tank and check for freedom of motion as follows: Raise the float arm as high as possible and then allow the float to fall slowly, by holding a finger under the float arm as it lowers. The float arm should show no sign of stickiness and should continue to fall to a vertical position.

Connect the transmitter to an indicator known to be in good working order. Move the float arm and note movement of indicator pointer. Any indication of hesitation or backward movement shows defective connections or unit. If unit is bad, replace.

If the resistance unit is found to be burned out, check external circuit before new resistance or instrument is installed.

b. Removal.- Due to the simplicity of mounting of both the indicator unit and transmitter unit, their removal should be apparent.

c. Installation.-

(1) Indicator.- Due to the simplicity of the mounting, the method of installing the indicator unit is apparent.

(2) Transmitter.- To install the transmitter unit, hold float and arm assembly parallel to the transmitter unit and the float in such a position that it will clear the tank opening without forcing. Turn the unit until the electrical receptacle is in the proper position. Align the holes in the flange with the studs in the tank, check to make sure the gasket is in place, seat the unit, and install nuts and safety wire.

The electrical connection is of the quick-change mating type.

d. Adjustment.- The tank must be empty so that the float will rest on the bottom of the fuel tank.

(1) Connect the indicator and transmitter.

(2) Loosen the four center screws on the top of the transmitter unit and rotate the adjusting disc until the pointer reads zero. Tighten the screws.

(3) If it is not possible to get an empty tank adjustment by rotating the adjusting disc, it will be necessary to make the following additional adjustment.

(a) Loosen the four screws on top of the transmitting unit.

(b) Rotate the adjusting disc until it reaches its mid-point of travel.

(c) Tighten the screws, enough to hold the adjusting disc.

(d) Note the indicator reading.

(e) Remove the six screws attaching the transmitter unit to the flange.

(f) Remove the transmitting element and rotate the shaft to a position where the indicator will give same reading as above.

(g) Determine and mark the position of the arrow with respect to the tank so that, when the transmitting unit is assembled to the shell, the receptacle and float arm will be in their correct position.

(h) With the shaft in this position, mark one end of the magnet and the case directly opposite the end of the magnet.

(i) Push the magnet against the spring and rotate the shaft until the cross pin aligns with the notch in the magnet, which makes the indicator read nearest to zero when the mark on the magnet and on the case are realigned. When the magnet has been released, this constitutes a rough empty tank adjustment.

(j) Replace the transmitting element in the shell and secure it in place with six screws.

(k) Loosen the four screws on top of the element and rotate the adjusting disc until the indicator reads exactly zero.

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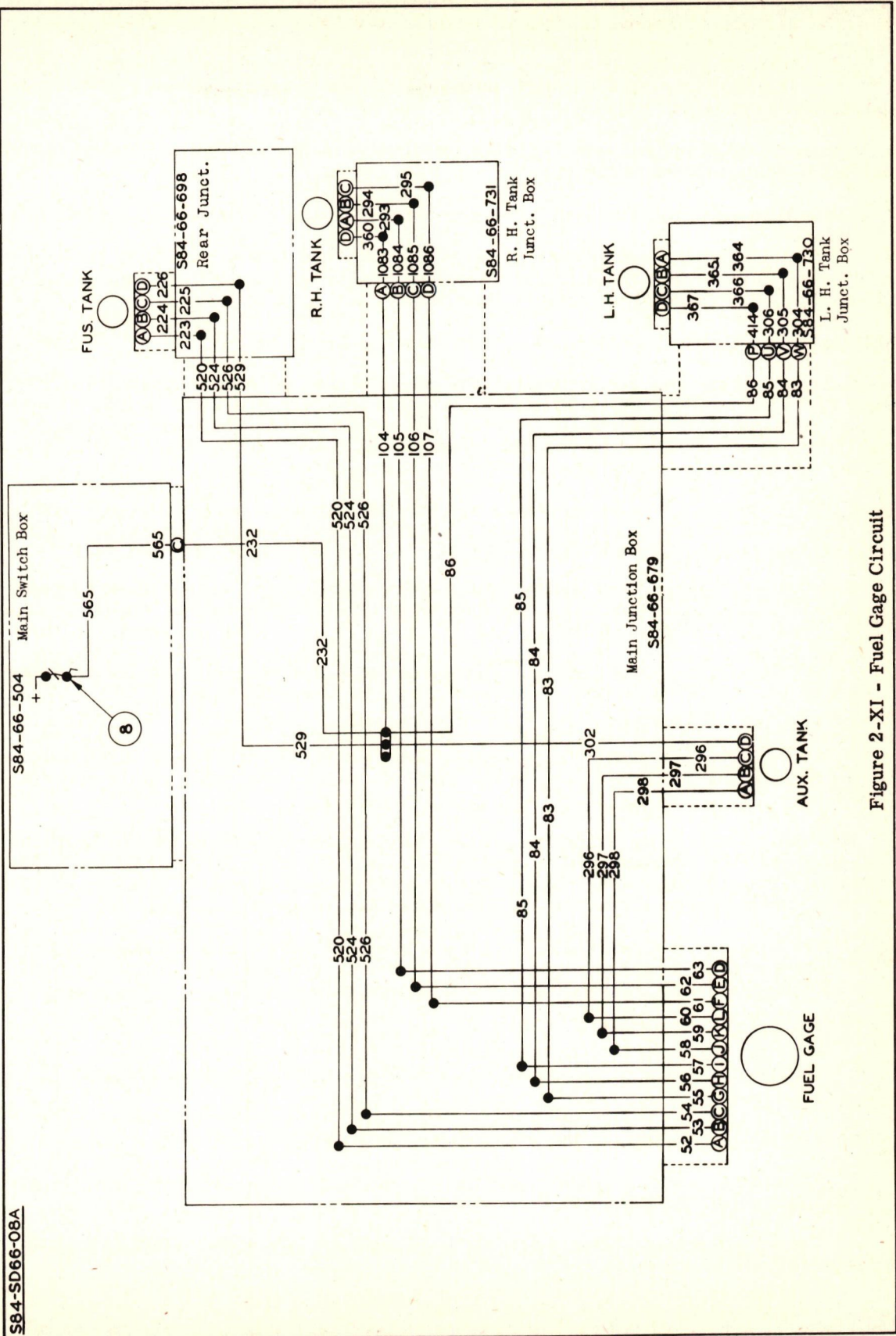


Figure 2-XI - Fuel Gage Circuit

(1) Tighten all screws and install safety wires.

For further information on fuel gages, refer to T. O. No. 05-55A-3 and section XVI.

11. Pitot Heater.

The pitot tube is equipped with two 35-watt heating coils to prevent icing. This heating unit is controlled by a rheostat control on the main switch panel.

The heating element is enclosed in the nose of the pitot tube and cannot be repaired or replaced individually.

The only check to be made is to feel the nose of the pitot tube to see if the heating coils are functioning or checking for noticeable voltage drop.

12. Lights.

a. Formation Lights.- The formation lights consist of one light on each wing tip. These lights may be turned on "STEADY" or "FLASH" by a "momentary" type switch on the main switch panel. The intensity of illumination is governed by the setting on the bright or dim switch. When the switch is on "BRIGHT," the current passes directly to the lamp. When the switch is on "DIM," the current must first pass through a resistance before going to the lamp.

(1) Maintenance.- These units will have very limited maintenance, consisting principally of replacement of lamps, lens, or complete assemblies. The procedures are very apparent. The assemblies are NAF-1073-30 and use 3 C. P. SC. lamp, type G-6 NAF 1068-17.

b. Recognition Lights.- The recognition lights are located on the right wing just inboard of the tip. This system consists of a white light on the upper surface and red, green, and amber lights, fore to aft on the lower surface.

All of the lights may be turned on together by use of the keying switch or operated independently by separate switches. The circuit does not require the battery switch to be "ON" and is protected by a breaker, which is normally "ON."

c. Section Light.- The section light, NAF 1073-25, with NAF 1068-17 lamp, is located on top of the rear cockpit enclosure at station 210, and is controlled by a switch on the main switch panel.

d. Running Lights.- The running lights are located one on each wing tip and one on the tail of the airplane. They are controlled through the main switch panel. With the switch in "BRIGHT" position, current is supplied directly through the switch to the lamps. With the switch in "DIM" position, the current must pass through a resistance before reaching the lamps.

The landing gear signal lights are in the same circuit with the running lights and are "ON" at all times when the running lights are "ON." These signal lights (NAF 1056-11) use 3 C. P. SC. NAF 1068-20 lamps, which are accessible through the landing gear wells in the wings.

The left-hand wing light is a Grimes A-1815-A1281 lens.

The right-hand wing light is a Grimes A-1815-A1280 lens.

The tail light is NAF 1071 or NAF 1072 with 3 C. P. SC. NAF 1068-17 lamp.

e. Landing Light.- The airplane is equipped with a Grimes (G-3200) AN3095-2 landing light. This is an electrically retractable, sealed-beam type of light.

The reflector, lens, and light are all in one sealed unit and no service is possible, except the checking of electrical contacts for security.

The retracting mechanism is powered by an electric motor, incorporated in the mounting, and is protected by a breaker.

The retracting mechanism and light are both controlled by a switch on the main switch box panel. The light automatically lights as the unit opens and is turned off as the unit closes.

The lamps are pre-focused to give the best possible beam of light and are not adjustable. However, the angle to which the lights open may be adjusted.

(1) Maintenance.- Because of the limited amount of use and the simplicity of operation and construction, the landing light will normally require very little service. The following will probably constitute the majority of maintenance checks.

(a) Check for discoloration of lamp. If it shows signs of discoloration, sealed beam unit should be replaced.

(b) Check for free operation of retracting mechanism.

(c) Inspect for security of mounting and all electrical connections.

(d) Inspect brushes and commutator for excessive wear or arcing.

(e) Check brake block on armature to make sure it releases when motor is operating.

(2) Removal.-

(a) Sealed Beam Unit.- The sealed beam unit may be removed without removing the entire lamp assembly.

1. Lower the light.

2. Unsnap the retainer ring.

3. Lower the sealed beam unit and disconnect the wires.

(b) Landing Light Assembly.- The entire landing light assembly may be removed from the airplane, if necessary, by the following procedure:

1. Remove the fifteen screws around the outer ring of the light assembly. Be sure to support light assembly so that it does not drop.

2. Bring the assembly slightly forward and down to clear the wing recess.

3. Disconnect the junction plug.

(3) Replacement.-

(a) Sealed Beam Unit.- The replacement procedure for this unit should be obvious from the above information.

(b) Landing Light Assembly.- The method of installing this unit is primarily the reverse of the removal procedure. However, care should be exercised in aligning the beam correctly at the time of installation.

(c) Brushes.- The entire assembly should be removed from the airplane if it becomes necessary to replace the brushes in the motor.

1. Remove the three screws from the motor end plate.

2. Remove the brush arms by a slight sideward pressure. Care should be taken not to stretch the spring between the two arms.

(4) Adjustment.-

(a) Opening Angle.- The opening angle of the lamp is adjustable from 50 degrees to 85 degrees, but is normally set at the factory to open to 73 degrees. This is done by:

1. Removing the four screws holding the plate opposite the motor housing.

2. Holding the light in its normal operating position, loosen the lock screw on the upper breaker arm assembly.

3. Open the lamp the desired number of degrees.

4. Adjust the breaker arm assembly by moving one way or the other, until the points just open. Tighten screw.

(b) Beam Angle. - The angle at which the light beam points from the center line of the airplane may be adjusted about eight degrees in either direction. This may be done by removing the fifteen screws in the mounting ring and turning the complete assembly one hole in either direction desired.

f. Cockpit Light. - The cockpit light NAF 1056-11 is located directly above the main switch panel. It uses a 3 C. P. SC. NAF-1068-20 lamp and is controlled by a switch on the main switch panel. The illumination is variable through a rheostat switch.

g. Spare Bulbs. - Spare light bulbs are located in a container on the right side of the front cockpit directly next to the dash board.

h. Fluorescent Lights (Front Cockpit). - There are two Grimes D-2332 fluorescent lights in pilot's cockpit. One on the right and one on the left at station 41. They are controlled by a Grimes A-2334 rheostat (which includes starting provisions) located forward of the main switch box. The battery switch on the main switch box must be "ON" before the fluorescent light switch is effective. The circuit is protected by a NAF 1131-15 circuit breaker which is normally "ON."

To operate the light, turn the knob to "START" position, hold for a few seconds; then turn knob to the left until desired intensity is obtained.

Maintenance of these lights will consist principally of checking electrical connections and replacement of bulbs.

To replace the bulb, remove the two screws securing the filter cap assembly and turn the bulb to the left as viewed from the top of the bulb.

NOTE: Do not look directly into the beam of the unshielded light; to do so will cause the temporary impairment of vision, due to fluorescence of the eyeballs.

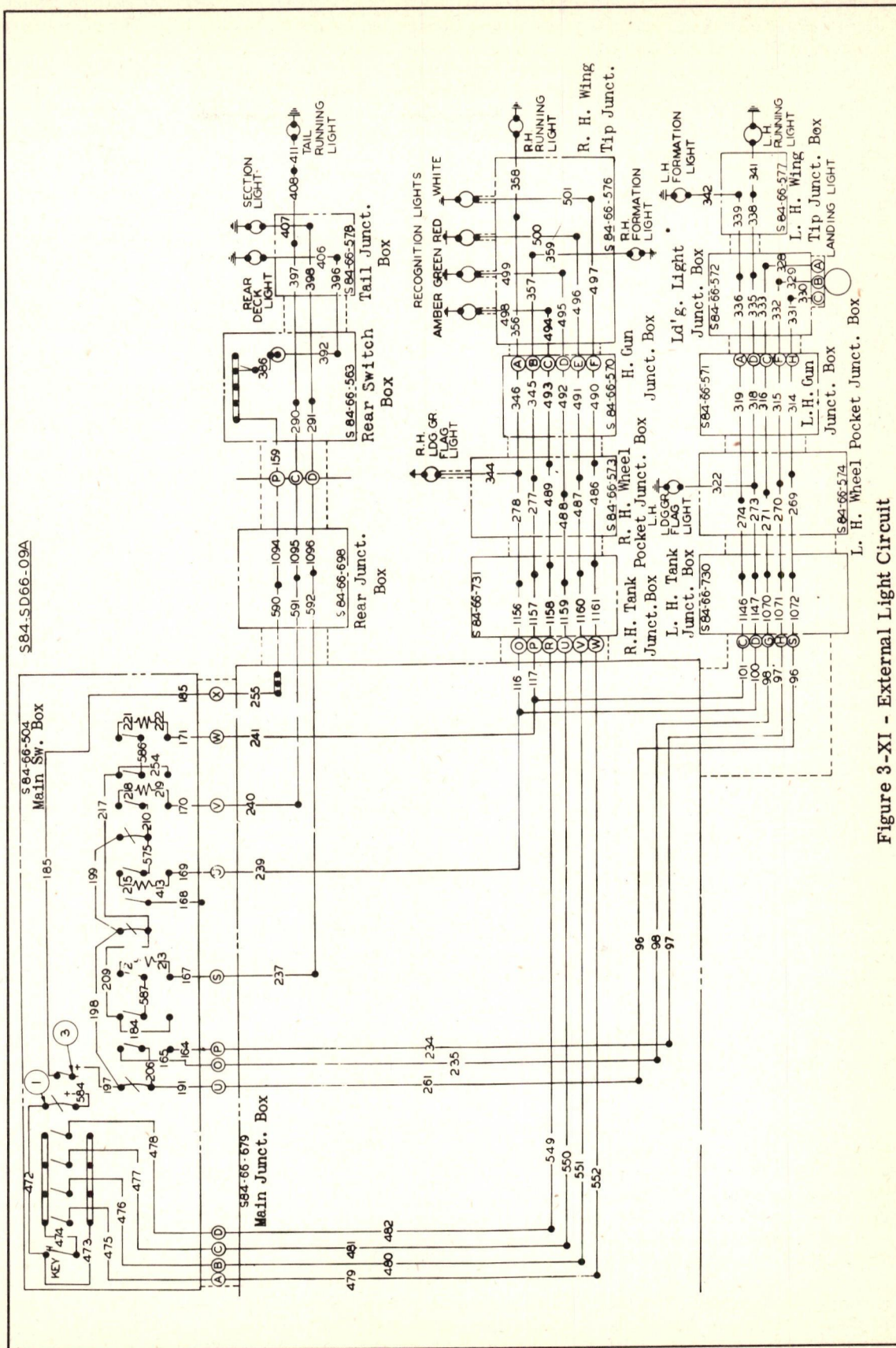
13. Armament Switch Box.

The armament switch box is located on the lower left side of the pilot's cockpit below the instrument panel. This switch box receives its current through the battery switch on the main switch panel. The armament switch box controls the following units when the main battery switch is "ON."

- Arming mechanism
- Bomb release
- Machine gun or cannon operation
- Bomb bay lights
- Gun sight light
- Camera

a. Arming Switch. - The arming switches operate the arming solenoids of all the bombs that are installed. When this switch is placed in "ARMED" position, the circuit is closed, energizing the solenoid which, through mechanical means, will pull out the arming pins or wire when the bombs are released. When this switch is in the "SAFE" position, the circuit is open and, if the bombs are accidentally released, the arming wire will be allowed to drop with the bombs, preventing accidental explosion of the bombs. The nose and tail arming mechanisms operate independently of each other. The solenoids are located in the bomb racks.

b. Bomb Release. - The wing and fuselage bombs are normally released by the trigger switch at the top of the control stick. With the battery switch "ON" and the trigger switch depressed, current flows through a breaker switch to the selected bomb release solenoid.



The fuselage bomb release circuits incorporate two micro-switches in series, a relay and selector switch. All fuselage bomb release circuits are protected by breakers. The circuit to the fuselage bomb release solenoids can be completed only when the bomb bay doors are open so that the arms on the forward section of the doors close both micro-switches located on each side of the fuselage at station 35. (These switches are accessible through the bomb bay doors.) With these switches closed, the circuit is complete to relay NAF 1118-2 in the armament switch box. As the relay is energized, the contacts are closed and supply current to the fuselage bomb selector switches. The current reaches the selector switches through the protective breaker switches.

When only a 1000-pound bomb, 1600-pound bomb, or torpedo is carried, only the center switch is used. This release solenoid can be operated by placing the switch in the "UP" or "DOWN" position before the trigger is pressed.

When 500-pound bombs are carried and it is desired to release only one bomb, place that switch in "UP" position and complete the circuit by pressing the trigger switch.

If a salvo is desired, i.e., releasing of the left and right fuselage bombs simultaneously, both switches must be placed down. The circuit to the right bomb release solenoid is completed as stated above, but an auxiliary relay and a time delay is cut into the left bomb circuit which delays the release 0.4 seconds later than the right bomb. The delayed action is accomplished as follows: When the left bomb switch is down, the bomb bay doors open, and the trigger switch depressed, current energizes the auxiliary relay, closing the contacts and permits current to flow from the power side to the time delay relay. This energizes the time delay relay, closing the points, and allows current to flow to the left bomb release solenoid with a delay of 0.4 seconds. This is necessary to prevent the two bombs striking each other as they are released. The release solenoids and arming devices are located in the bomb racks. The relays are located in the armament switch box.

(1) Removal. - The fuselage bomb racks (MK-51 Mod. 7) may be removed by disconnecting the bonding, disconnecting the electrical connection at the junction plug next to the rack, and removing the three bolts securing the rack to the fuselage at each end.

The removal of the armament switch box itself is quite obvious. Each unit in the switch box may be removed by breaking the electrical connections and removing the two retainer screws, except the rheostat, which must first have the knob removed from the outside.

(2) Maintenance. - The system should require very little maintenance service because of the simplicity of the units involved. Check all electrical connections for security and corrosion. Check the contact points of the two relays in the switch box for pitted or burned condition. If necessary, clean points with emery polishing paper (grade 1/0 or 2/0) or crocus cloth and blow out with dry air.

If the arming device or release fails to function, test at the bomb rack junction with a buzzer or light to see if current is reaching unit. If the test shows current is flowing to the bomb rack junction when the circuit is closed, the solenoid in the bomb rack is defective and should be replaced.

If the test shows no current flowing to the bomb rack with the circuit closed, check back through the circuit at each unit, in the same manner, until the defective unit is found. Replace or repair as necessary.

(3) Test. - The bomb rack electrical mechanism should be tested thoroughly for operation before each flight. This can be done by cocking the release mechanism and closing the release circuits from the switch box. Also test the arming device by observing its action when the switches are manipulated.

For further information on arming and bomb release, see section VIII.

c. Machine Gun Operation. - The armament switch box receives current through a breaker on the main switch panel. Two additional breakers on the armament switch panel serve to select the guns to be fired. Actual firing of the guns is accomplished by closing the trigger switch on the control stick which completes the circuit through gun firing solenoids on the selected guns.

The solenoid MK-5 is located on the side of the gun and is adjustable by turning the adjustment plate on the end of the solenoid and using the recommended gages. Refer to T. O. No. 11-1-30 for adjustment procedure.

(1) Maintenance. - To test the operation of the solenoid, remove assembly from the gun, install electrical connection, and make sure solenoid is grounded. Operate solenoid by opening and closing circuit, and observe if action is free of drag or binding. If solenoid fails to function, substitute a solenoid known to be in good operating condition and repeat test. If replacement solenoid fails to operate, check back through the circuit for loose connections, defective trigger switches, or control box switches.

Refer to section VIII.

d. Bomb Bay Lights. - The bomb bay lights are located, one in each end of the bomb bay and are controlled by a breaker switch on the armament switch box. These lights normally will require very little maintenance with the exception of routine checks for loose or dirty connections and replacement of bulbs (6 C. P. SC. NAF 1068-18).

e. Gun Sight Lamp. - The gun sight is equipped with a double filament light bulb, controlled by a switch on the armament switch box. When this switch is "ON," one filament receives the current and the other filament receives current when the switch is in "ALTERNATE ON."

Maintenance (electrical) on this unit will consist principally of replacing bulbs and checking all contacts and electrical connections.

f. Camera. - The camera is so connected that it may be operated with the guns, bombs, or independently, as desired. It is electrically operated and controlled by switches on the armament switch panel and the circuit is protected by circuit breakers. It is not necessary to place the master switch "ON" to operate the camera.

14. Propeller Pitch Control.

The airplane is equipped with a Curtiss electrical propeller. The blade angles are controlled by a reversible electric motor in conjunction with power unit assembly and governor. Current control is established through a selector switch box located on the left of the pilot at station 35. This box contains a breaker and selector switch, having four positions: "AUTOMATIC," "INCREASE RPM," "DECREASE RPM," and "OFF."

A radio frequency filter, located at station 20 below the armament switch box, is used in the circuit between the breaker and the selector switch, to eliminate radio interference.

The governor is mounted on the governor drive pad on the front case of the engine and controls the constant rpm of the propeller by controlling the flow of current to the pitch changing electric motor in the hub.

a. Maintenance. - Because of the functional importance of the units involved, extreme care must be exercised in checking the propeller circuit. The following test should be carefully made.

(1) Daily and 25 Hours. -

(a) Visually inspect control rods for loose, worn, or damaged condition.

(b) Inspect all electrical connections for security.

(c) Inspect all flexible conduits for security or damage.

(d) During the engine run-up, make the following operational checks. With the battery and generator switches and the circuit breaker "ON," the selector switch in "AUTOMATIC," the mixture control in "AUTOMATIC RICH," and the governor control in "TAKE-OFF RPM," increase engine speed to approximately 1000 rpm. Hold the selector switch in "DECREASE RPM" until a decrease of approximately 200 rpm is noted.

Now hold the selector switch in the "INCREASE RPM" position until the original engine speed is resumed. These tests show that the pitch changing mechanism is working properly.

S84-SD66-10A

Main Sw. Box

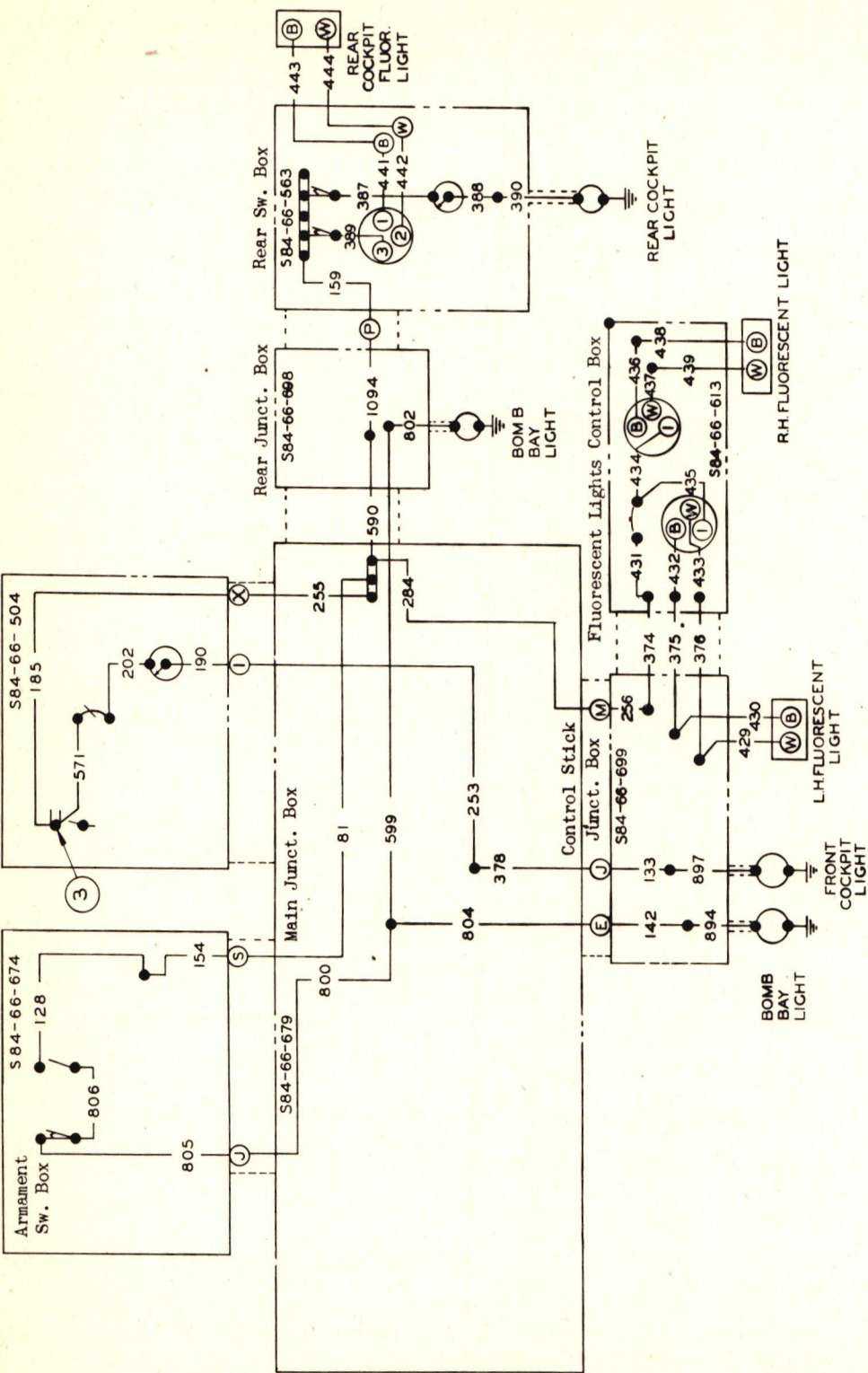


Figure 4-XI - Interior Light Circuit

S84-SD66-18A

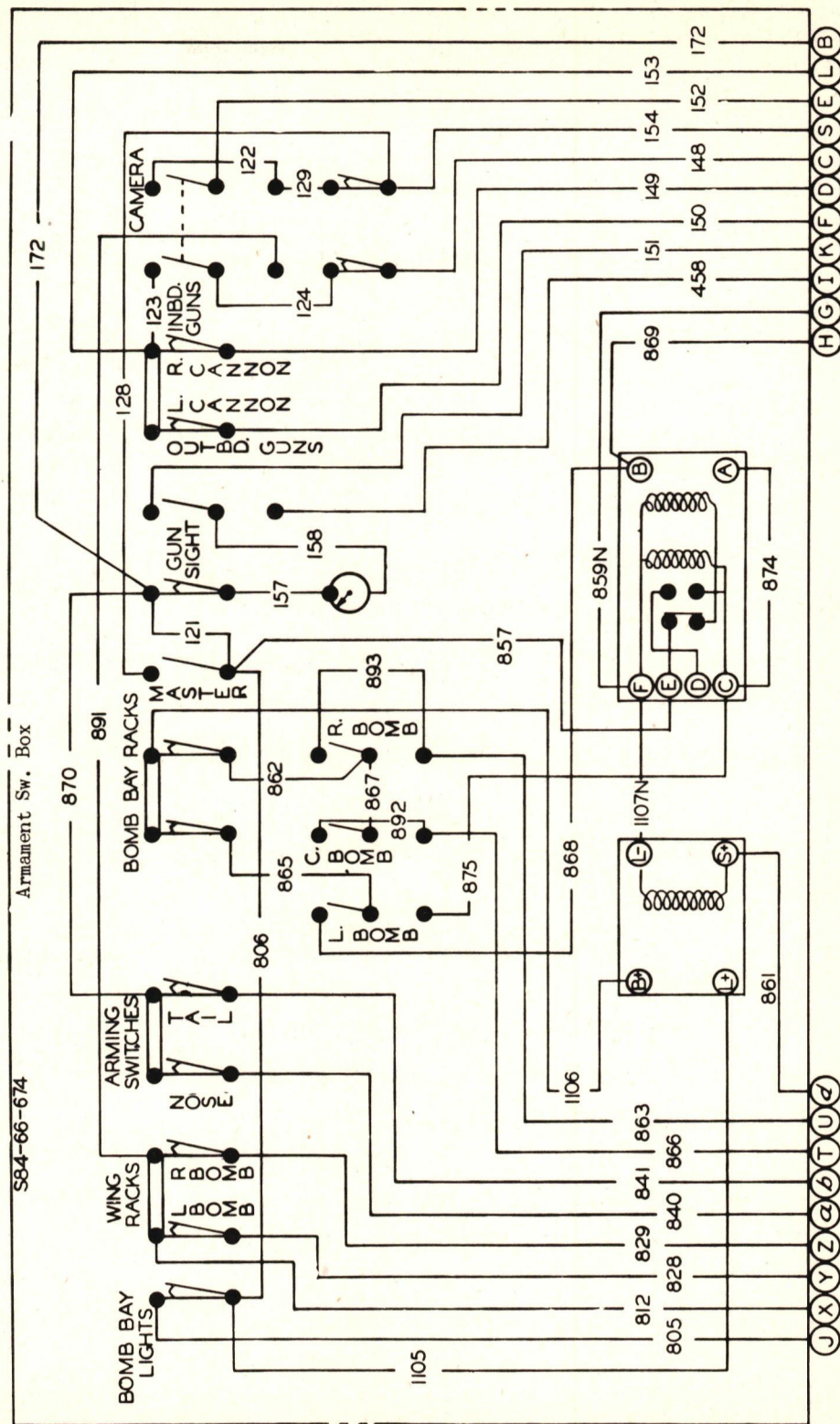


Figure 5-XI - Armament Switch Box Circuit

To check the automatic operation, place the selector switch in "AUTOMATIC" and the governor cockpit control lever in "TAKE-OFF RPM" position. Open the throttle until the engine speed reaches approximately 2000 rpm. Pull the governor control towards the "DECREASE RPM" position until a decrease of not more than 200 rpm is noted. At this rpm, the propeller should hold the engine at a steady speed.

Return the governor control to "TAKE-OFF RPM" and the engine should resume its original speed.

(2) 50-Hour Check (to include all daily and 25-hour checks).-

(a) Remove the brush assembly from the housing by releasing the two latches. Wipe the slip rings with a cloth, while the propeller is being manually rotated, and inspect rings for wear.

(b) Clean brushes and brush holders.

(c) Check for free movement of brushes in holders.

(d) Check for excessive wear of brushes. The brushes are inscribed with an arrow. When the brushes are worn to the tip of the arrow, the brush must be replaced.

(e) Check and adjust governor controls rods.

(3) 100-Hour Check (to include daily, 25-hour and 50-hour checks).-

(a) Check governor by removing switch compartment cover.

1. Condition of contacts. Clean or replace if necessary with crocus cloth.

2. Remove dirt and grease from assemblies with fluid cleaner.

(b) Relay should be partially removed from box and checked for:

1. Free movement of transverse arms.

2. Alignment of armature. This adjustment is made by bending the upper transverse arm and/or the fixed contact supports.

With the armature stem against the coil housing, there should be at least .008-inch gap between the outer edge of the armature T head and the upper transverse arm, on the side of the closed contact.

The contacts should close within 10 to 16 volts.

3. Test condenser if radio interference is experienced.

Set ohmmeter for high resistance range. Place one lead to the condenser case and the other to the contact.

The meter should give a short, quick response.

Reverse the leads of the ohmmeter. The needle should show a little greater deflection than the first test.

A full and permanent deflection of the ohmmeter indicates a shorted condenser. Replace it.

No deflection of the needle indicates a burned condenser fuse. Replace assembly.

4. Examine the resistor for general condition and resistance. The resistance at 24 volts should be 800 ohms.



5. Examine all terminals and wires for general condition.

b. Engine Surging. - If the engine surges when propeller is in "AUTOMATIC" position, switch to "FIXED PITCH" position. If surging stops, check propeller control system.

- (1) Inspect relay for proper adjustment.
- (2) Inspect governor contact points to see if they are clean and free from oil.
- (3) Check governor assembly for freedom of operation.

c. Sluggish Operation. - If the propeller responds slowly to control changes:

- (1) Check operation of brake assembly.
- (2) Inspect governor contact points to see if they are clean.
- (3) Check the relay.
- (4) Check motor for drag, dirty brushes, weak brush springs, binding brushes, and mechanical defects.
- (5) Check all electrical connections in circuit.
- (6) Check mechanical parts of assembly.

d. Circuit Breaker Fails to Stay Closed. - This is usually caused by an overload condition.

- (1) Check system for short circuits.
- (2) Inspect brake for operation and adjustment.
- (3) Inspect motor for excessive drag.

e. Propeller Fails to Operate. -

(1) Test for open circuit to the slip rings with a light or buzzer. If this test indicates no open circuit, trouble is in the propeller itself. Check for shorts, grounds, open circuits, or binding condition.

(2) If test shows no current flowing, the trouble lies in the control system. If so, check with continuity test until defect is located.

If the propeller operates manually but not automatically, the difficulty is in the governor or relay.

For complete information concerning the operation and maintenance of the propeller units, refer to section XII, or T. O. No. 03-20B-1 and T. O. No. 03-20B-2.

15. Rear Switch Box.

The rear switch box is located on the right side of the rear cockpit at station 135. This box contains switches for the following units.

a. Fluorescent Lights. - The fluorescent light system in the rear cockpit is the same type as the front cockpit. The light is located on the right side of the cockpit at station 155 and is controlled from the rear switch box, which has the starting unit and rheostat.

b. Spot Light. - The spot light is located on the left side of the rear cockpit. The light is controlled by a rheostat type switch on the rear switch panel. The spare bulbs are located in a container clearly marked along side of the switch box.

c. Gun Master. - This switch controls the flow of current to the turret switch box.

16. Turret Electrical System.

Current is supplied from the "Gun Master" switch to the turret switch box through a contact at the bottom of the swivel assembly. Current passes directly from the contact to the turret lock switch and trigger switch on the control stick and to the camera and gun sight switch on the control panel.

The gun firing solenoid MK-11 and ammunition booster circuits are completed through the control stick switch, a 20 ohm resistor (ohmite or equivalent) and two relays, one for each circuit. By closing the gun camera switch on the control panel, the camera may be used in conjunction with the gun.

A micro-switch under the turret floor contacts a cam which is designed to break the circuit to the gun firing solenoid and ammunition booster whenever a part of the airplane structure comes in the line of fire of the turret gun. This gun circuit is completed through a bypass switch which is normally closed. Opening the bypass switch eliminates the fire interrupter switch from the circuit.

The vertical movement of the flexible gun is controlled by two micro-switches which operate in conjunction with the hydraulic system, to limit the movement from 85 degrees above to 70 degrees below the horizontal plane of the airplane. One switch is located to the left of the gun on the channel running from the turret ring to the floor. The other switch is located forward of the control stick and is normally open. If the gun attains an elevation of 85 degrees, the lock valve circuit is opened by the gun micro-switch, preventing further movement. However, the system can be brought into operation again by moving the stick forward to close the stick micro-switch. This action automatically starts the gun in a downward movement and allows the gun micro-switch to close and restore the circuit to its normal arrangement.

The gun heater is controlled through a switch on the control panel.

The camera and illumination for the gun sight are controlled through switches on the control panel.

a. Maintenance. - Maintenance of the turret electrical system will consist of preflight operational test, to determine if all units are in operating condition, and inspection of all electrical connections for security and cleanliness.

Listed below are some of the possible electrical troubles, their probable cause and remedy.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
(1) Gun fails to fire.	(a) Defective solenoid.	1. Test operation of plunger for sticking. Use a buzzer to test continuity of winding.
	(b) Solenoid not correctly adjusted.	1. Adjust. (Instructions are usually given on side of solenoid.)
	(c) Open circuit.	1. Use a light or buzzer and check circuit, beginning at solenoid and tracing back toward power source. Correct as necessary.
	(d) Defective trigger switch.	1. Remove switch from stick and use a jumper across wires. If defective, replace switch.
	(e) Defective relay.	1. Check for pitted or burned points. Incorrect point spacing. Test for short or grounded coil. Correct or replace.
	(f) Defective resistor.	1. Use ohmmeter test resistance. It should be 20 ohms. If defective replace.

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
	(g) Defective interrupter switch.	1. Test for ground or short circuit particularly in contact arm.
	(h) Incorrect wiring.	1. Check wiring diagram and correct.
(2) Ammunition booster fails to operate.	(a) Open circuit.	1. Use a light or buzzer and check circuit beginning at booster motor.
	(b) Defective relay.	1. See (e) above.
	(c) Incorrect wiring.	1. Check wiring diagram and correct.
	(d) Defective booster motor.	1. Check motor and repair or replace.
(3) Gun remains in upper elevation.	(a) Defective stick micro-switch.	1. Check for sticking plunger. Use a jumper across switch. Replace, if defective.
	(b) Defective gun valve solenoid.	1. Check action of plunger and use buzzer or light to check continuity. Replace or repair if defective.
	(c) Incorrect wiring.	1. Check wiring diagram and correct.
(4) Turret fails to operate	(a) Defective lock switch.	1. Remove switch from stick and use jumper across leads. Replace if defective.
	(b) Defective lock solenoid.	1. See (b) above.
	(c) Incorrect wiring.	1. Check wiring diagram and correct.
	(d) Open circuit to lock solenoid.	1. Use a light or buzzer and make a continuity test beginning at the solenoid and tracing toward power source. Correct as necessary.
(5) Camera fails to operate with gun.	(a) Open circuit between relay junction and camera.	1. Use test light or buzzer test from camera to junction. Correct as necessary.
	(b) Incorrect wiring.	1. Check wiring diagram and correct.
(6) Fire interrupter fails to operate.	(a) Dirt, oil, or corrosion on cam.	1. Clean cam and contact.
	(b) Defective contact on arm.	1. Check for wear, burns, or pits. Check spring tension. Replace is necessary.
	(c) Open circuit.	1. Use test light or buzzer beginning at ground connection of cam; check toward trigger switch. Correct as necessary.
	(d) Defective bypass switch.	1. Use jumper across switch. Replace if defective.

(7) Breaker switches will not remain "ON."

(a) Over-load either electrical or mechanical.

1. Examine mechanical units for binding, locking, etc. and correct.

(b) Short circuits.

1. Test circuit for excessive draw and correct.

NOTE: The above table pertains only to the electrical circuits of the turret system. Some of the same troubles may be caused by mechanical failures involving the various units. Examine the mechanical operation thoroughly before condemning any part of the electrical system.

17. Junction Boxes.

The following is a list of the junction boxes, their numbers, and approximate locations.

S84-66-570 Right-hand gun junction box aft of rear main beam, wing station 120.
S84-66-571 Left-hand gun junction box aft of rear main beam, wing station 120.
S84-66-572 Landing light junction box aft of rear main beam, wing station 130.
S84-66-573 Right wheel pocket junction box forward of front main beam, wing station 75.
S84-66-574 Left wheel pocket junction box forward of front main beam, wing station 75.
S84-66-576 Right-hand wing tip junction box forward of main beam, station 280.
S84-66-577 Left-hand wing tip junction box forward of main beam, station 280.
S84-66-578 Tail junction box station 240.
S84-66-587 Propeller governor junction box. Front cover of engine.
S84-66-643 Relay junction box left side pilot's floor station 18.
S84-66-679 Main junction box left forward side of fire wall.
S84-66-698 Rear junction box right center panel, fuselage station 114.
S84-66-699 Control stick junction box left side of fuselage beneath floor, station 66.
S84-66-730 Left-hand tank junction box forward of front main beam.
S84-66-731 Right-hand tank junction box forward of front main beam.



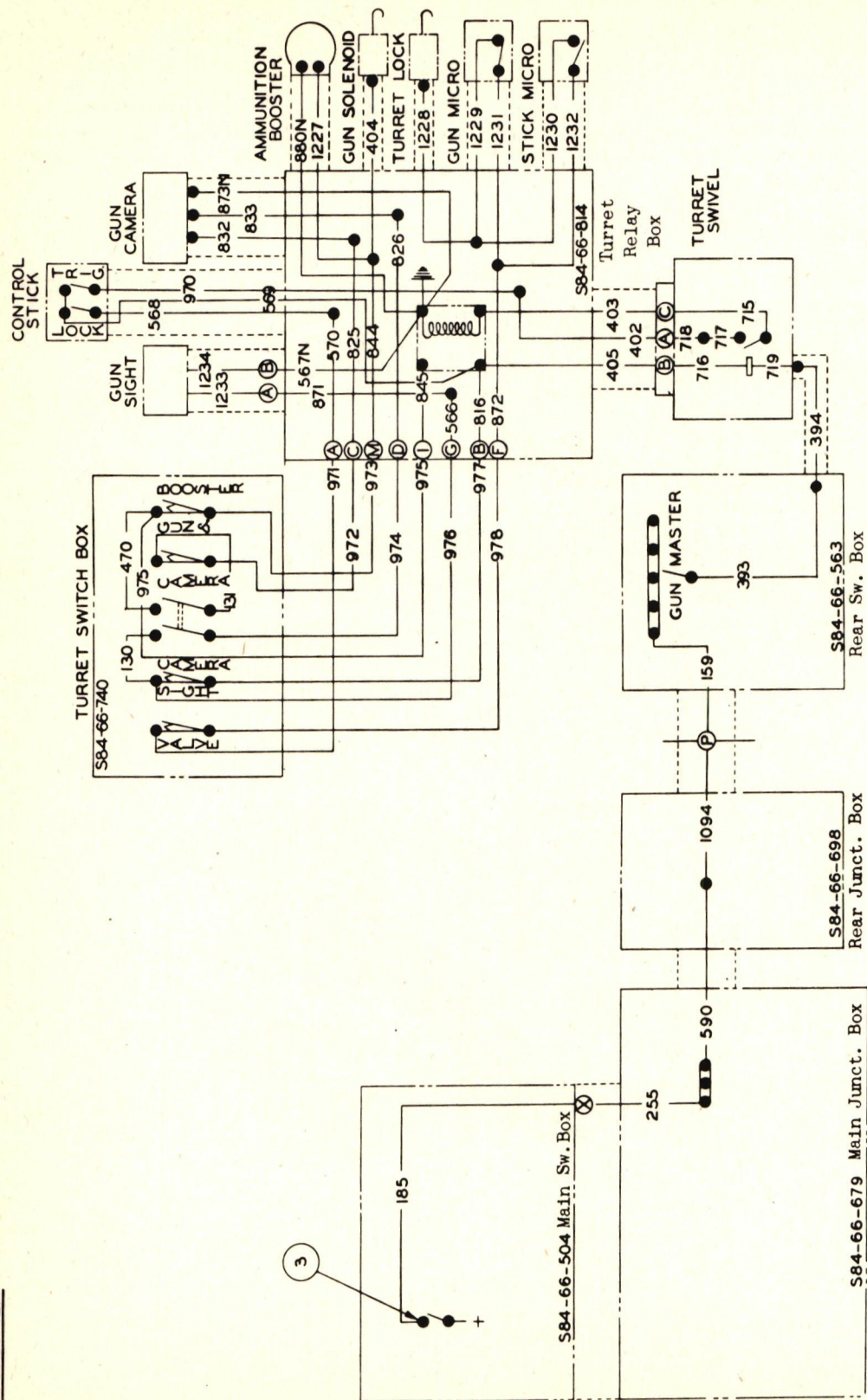


Figure 7-XI - Turret Circuit

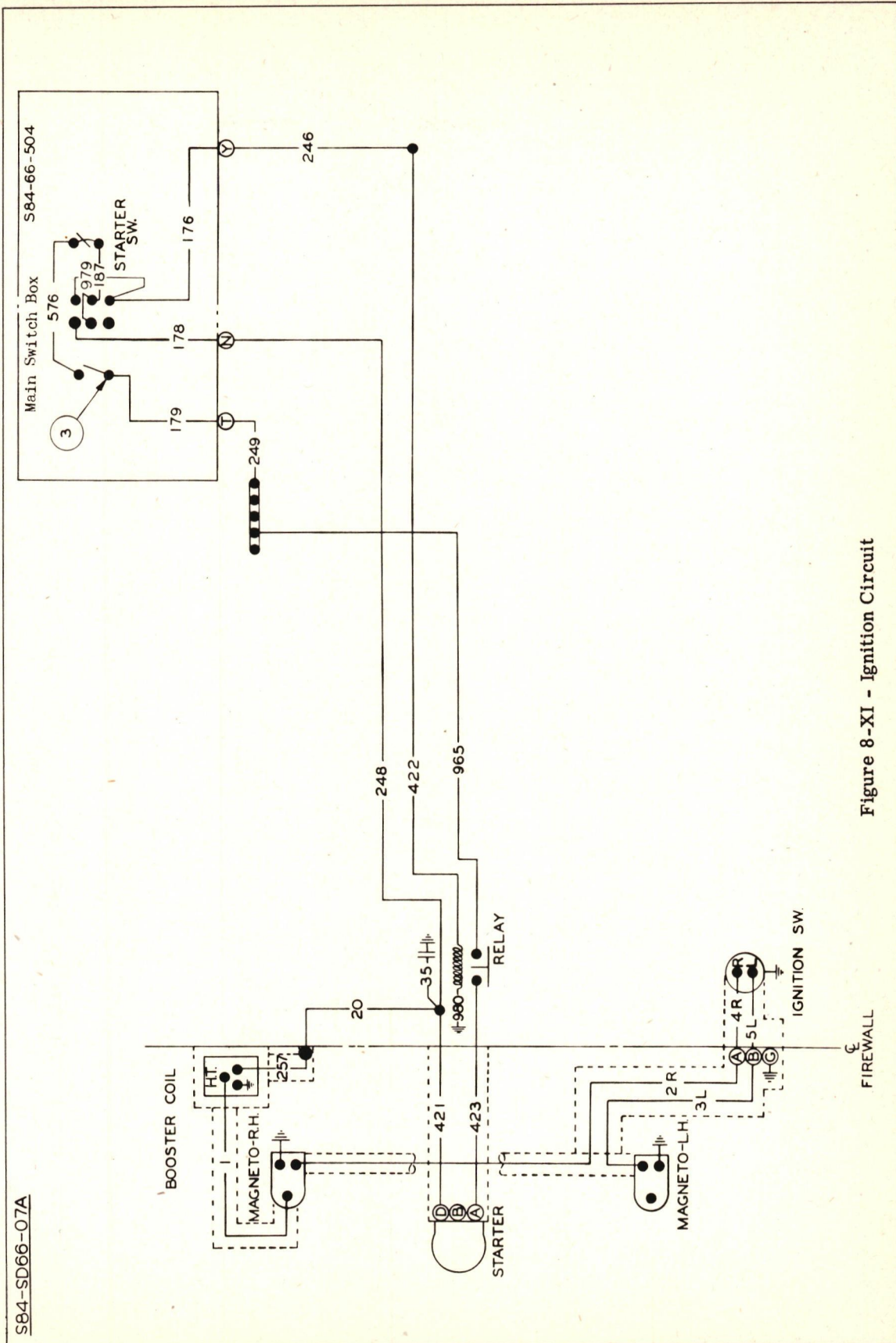


Figure 8-XI - Ignition Circuit

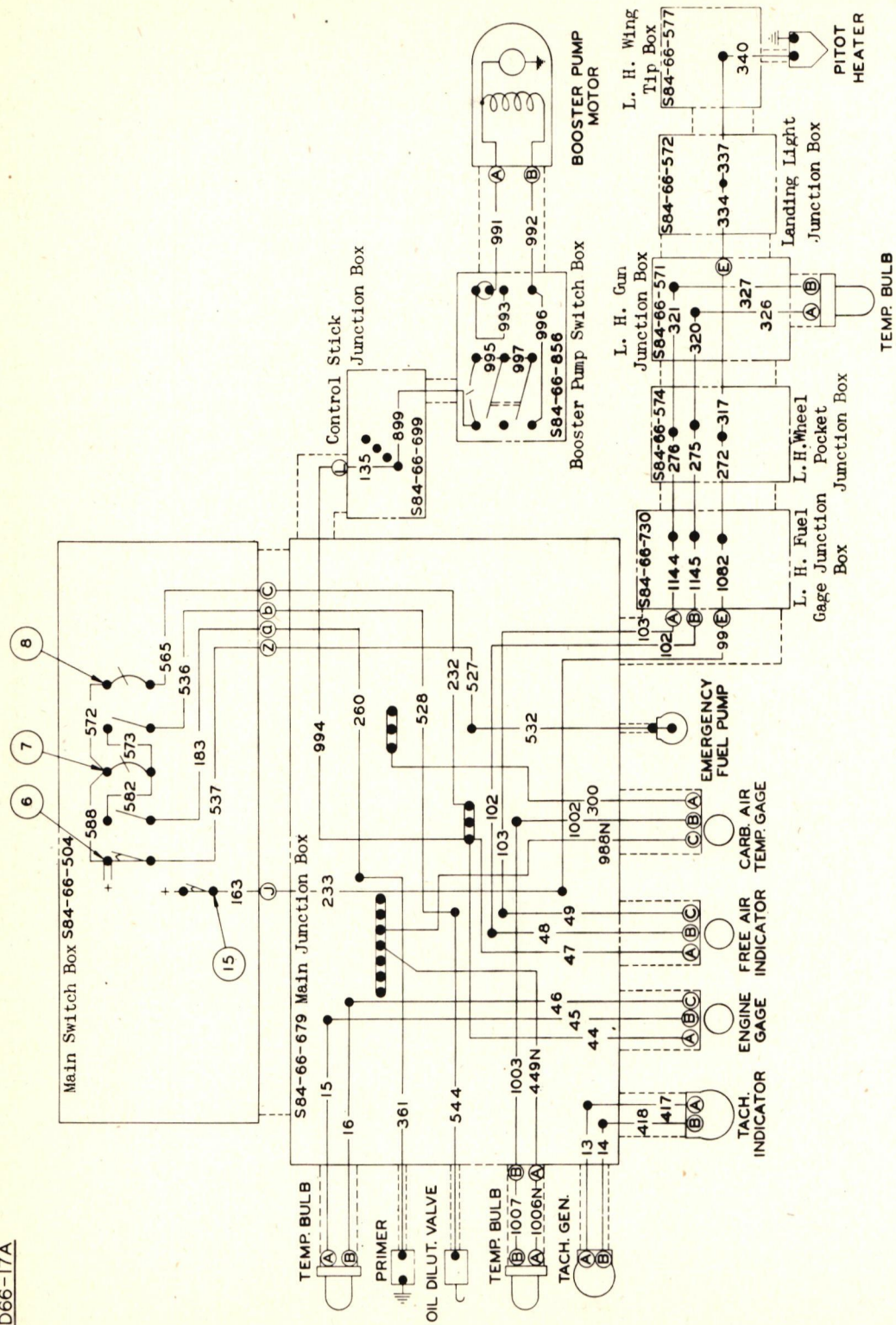


Figure 9-XI - Miscellaneous Circuits

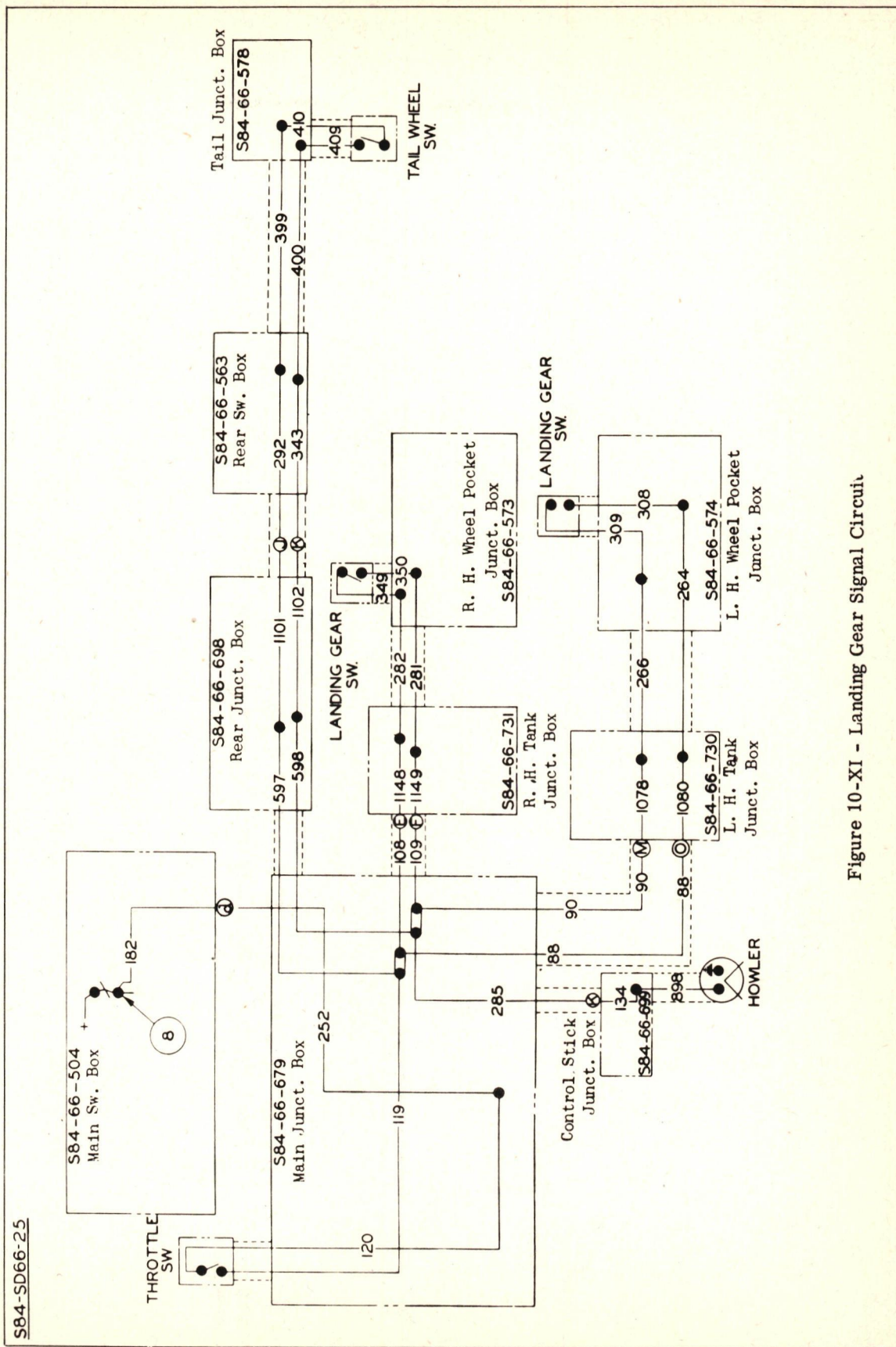


Figure 10-XI - Landing Gear Signal Circuit

S84-SD66-02

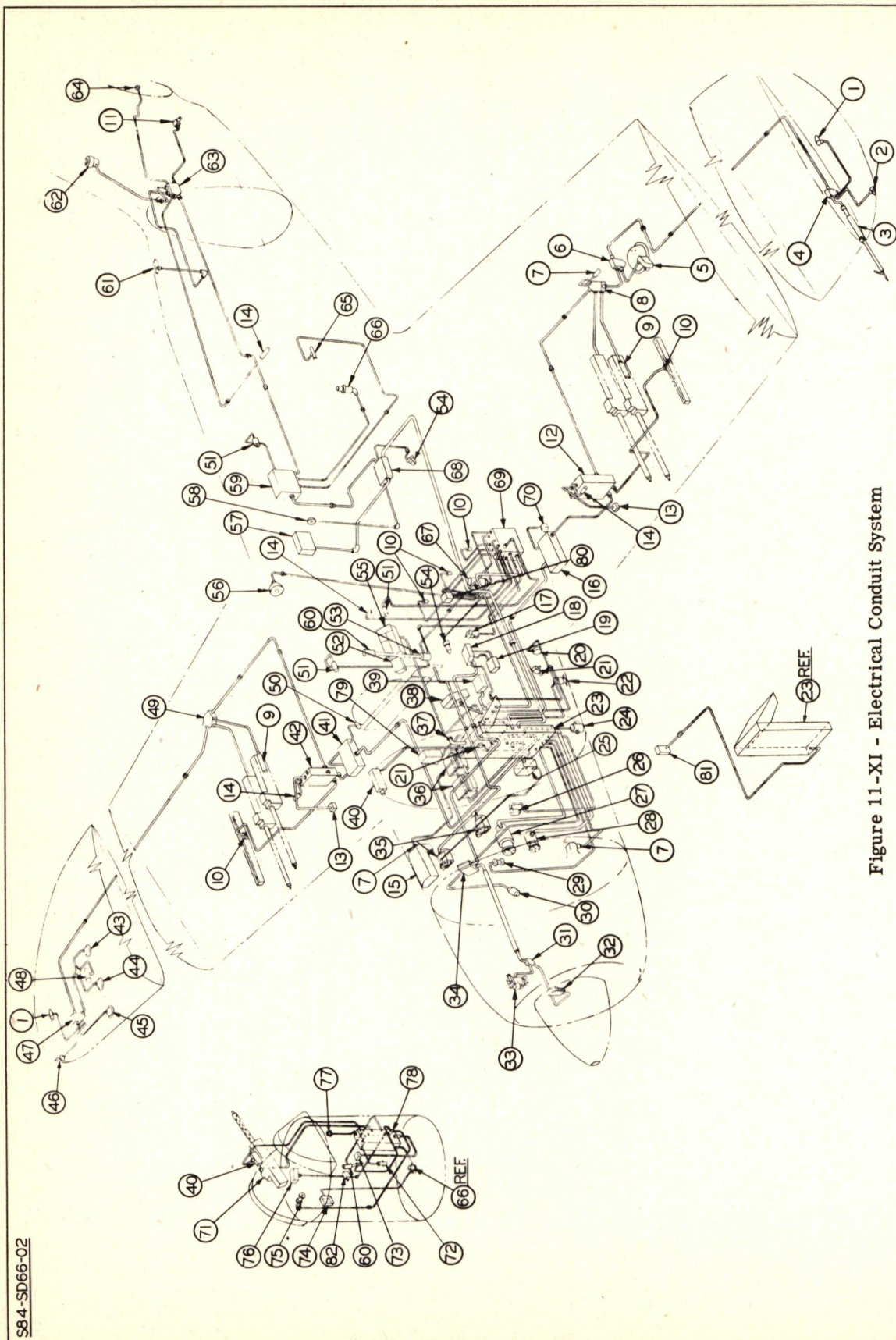


Figure 11-XI - Electrical Conduit System

PARTS LIST - ELECTRICAL CONDUIT SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	2	Formation Light	NAF1073-30
2	1	Running Light (Red)	Grimes A-1815 Type P
3	1	Pitot Static Tube	S84-66-554
4	1	Left-Hand Wing Tip Junction Box	S84-66-577
5	1	Landing Light	AN3095-2
6	1	Landing Light Junction Box	S84-66-572
7	3	Resistance Bulb Temperature Indicator	FSSC88-B-900
8	1	Left-Hand Gun Junction Box	S84-66-571
9		Fixed Gun Solenoid (Ref.)	S84-SD69-09A
10	5	Bomb Rack Plug	AN3106-14S-5S
11	1	Micro-Switch	WZ-2RQTC1
12	1	Left-Hand Wheel Pocket Junction Box	S84-66-574-2
13	2	Micro-Switch	Micro Switch Corp. WZ-7RAT
14	3	Light	NAF1056-16
15		Air Scoop (Ref.)	S84-51-512
16	1	Left-Hand Tank Junction Box	S84-66-730-501
17	1	Micro-Switch	GRL-5
18		Propeller Switch Box (Ref.)	S84-SD42-12A
19		Propeller Filter Box (Ref.)	S84-SD42-12A
20		Transmitter (Ref.)	S84-SD44-02A
21	1L & 1R	Bomb Door Switch	S84-66-537
22		Emergency Fuel Pump (Ref.)	S84-SD44-02A
23	1	Main Junction Box	S84-66-679-1
24		Anti-Icer Pump (Ref.)	S84-SD80-01
25	1	Booster Coil Box	S84-66-1016
26		Oil Dilution Solenoid (Ref.)	S84-SD44-02A
27	1	Starter	JH5F593
28	1	Generator	G.E. 2CM-70-B2
29	1	Primer	
30	1	Generator Tachometer	88-G-1380
31		Governor Junction Box (Ref.)	S84-SD42-12A
32		Brush Assembly (Ref.)	S84-SD42-12A
33		Governor (Ref.)	S84-SD52-01A
34		Propeller Relay Box (Ref.)	S84-SD42-12A
35	2	Magneto	Bendix SF14LN3
36	2	Battery	NAF1062-17
37	1	External Power Receptacle	97-5107-28-7S *
38	1	Armament Switch Box	S84-66-674
39	1	Relay Junction Box	S84-66-643
40		Gun Camera (Ref.)	S84-SD69-07A
41	1	Right-Hand Tank Junction Box	S84-66-731-501
42	1	Right-Hand Wheel Pocket Junction Box	S84-66-573-2
43	1	Recognition Light (Amber)	Grimes B-2389
44	1	Recognition Light (Green)	Grimes B-2389
45	1	Recognition Light (Red)	Grimes B-2389
46	1	Running Light (Green)	Grimes A-1815 Type P
47	1	Right-Hand Wing Tip Junction Box	S84-66-576
48	1	Recognition Light (White)	Grimes B-2115
49	1	Right-Hand Gun Junction Box	S84-66-570
50		Right-Hand Tank Transmitter (Ref.)	S84-SD44-02A
51	3	Fluorescent Light	Grimes D-2332
52	1	Fluorescent Light Box	S84-66-613
53		Socket Assembly (Ref.)	S84-SD64-02A
54	2	Bomb Bay Light	NAF 1111-1 **
55	1	Main Switch Box	S84-66-504-50
56	1	Howler Navy Specification	M-501 - Type B
57		Radio Junction Box (Ref.)	S84-SD67-01A

PARTS LIST - ELECTRICAL CONDUIT SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
58		Transmitter (Ref.)	S84-SD44-02A
59	1	Rear Switch Box	S84-66-563
60	2	Trigger Switch	NAF-1137-2
61	1	Rear Section Light	NAF-1073-25
62	1	Remote Indication Compass Transmitter	FSSC88-T-1950
63	1	Tail Junction Box	S84-66-578
64	1	Plug	AN3100-10S-2S
65	1	Light Assembly	NAF-1018-1
66		Turret Swivel Assembly (Ref.)	S84-SD66-01A
67		Booster Pump (Ref.)	S84-SD44-02A
68	1	Rear Junction Box	S84-66-698-501
69	1	Control Switch Junction Box	S84-66-699-501
70		Left Hand Tank Transmitter (Ref.)	S84-SD44-02A
71	1	Flexible Gun Solenoid	B.O. 300186 MK V-1
72		Turret Lock Magnetic Valve (Ref.)	S84-SD33-31
73	1	Stick Micro-Switch	YZE-7RQTN
74	1	Turret Radio Junction Box	S84-SD67-01A
75	1	Ammunition Booster	Hughes Aircraft 22814
76	1	Turret Switch Box	S84-66-740
77	1	Gun Sight Receptacle	NAF-1077-2
78	1	Turret Junction Box	S84-66-814
79	1	Voltage Regulator	G.E. 3GBD1A18
80	1	Booster Pump Switch Box	S84-66-1017
81	1	External Receptacle	S84-66-1022 ***
82	1	Micro-Switch	WZE-7RQTN

* 97-5107-28-7S power receptacle on ships 41-18774 through 42-79672.

** NAF1111-1 bomb bay light on ships 41-18774 through 42-79672. Ships 42-79673 and up use S84-66-1027 bomb bay light.

*** S84-66-1022 power receptacle on ships 42-79673 and up.



Section XII

PROPELLER AND PROPELLER CONTROLS

1. Introduction.

A three-bladed Curtiss electric propeller 12 feet in diameter and the necessary accessory equipment is installed on the A-25A Airplane. The low pitch setting is 21.7 degrees which with the normal 30 degrees pitch range establishes the high pitch setting at 51.7 degrees.

The installation includes the following major items:

Propeller, model No. C5325D-A6
Hub, No. 102605K
Blade, No. 89324-12
Power unit assembly, No. 109964-30
Speed reducer, No. 109959-10
Motor, No. 108951-22
Brush assembly, No. 104968-1
Governor, model No. 100008-1
Relay, No. 102901-1
Spinner, No. 109839

The information following in this section covers first and second echelon maintenance of this installation, and has been prepared by the Curtiss Propeller Division for the St. Louis Airplane Division.

2. Operation of Propeller.

a. Principle of Operation.- The blade angles of the Curtiss electric propeller are controlled by means of a reversible electric motor. The electrical energy required for operating the motor is taken from the airplane power supply and passes through brushes mounted in a housing attached to the engine nose, and then to slip rings which are fixed to the rear of the propeller hub.

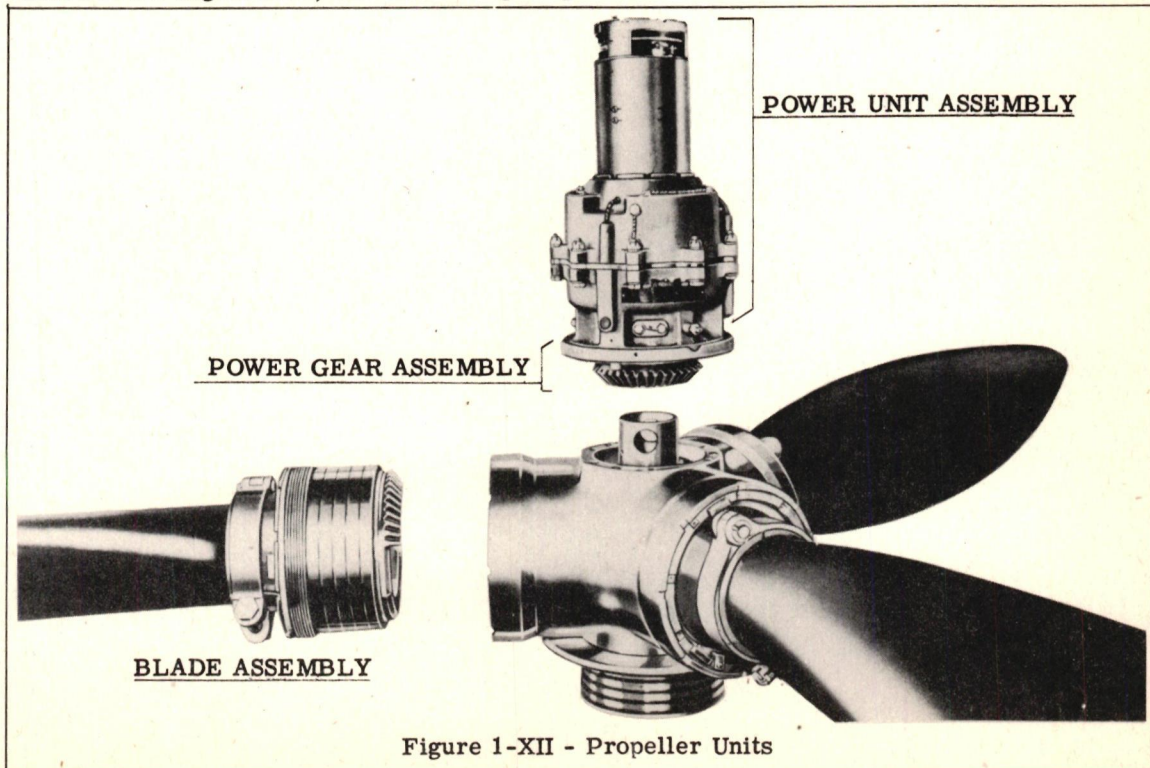
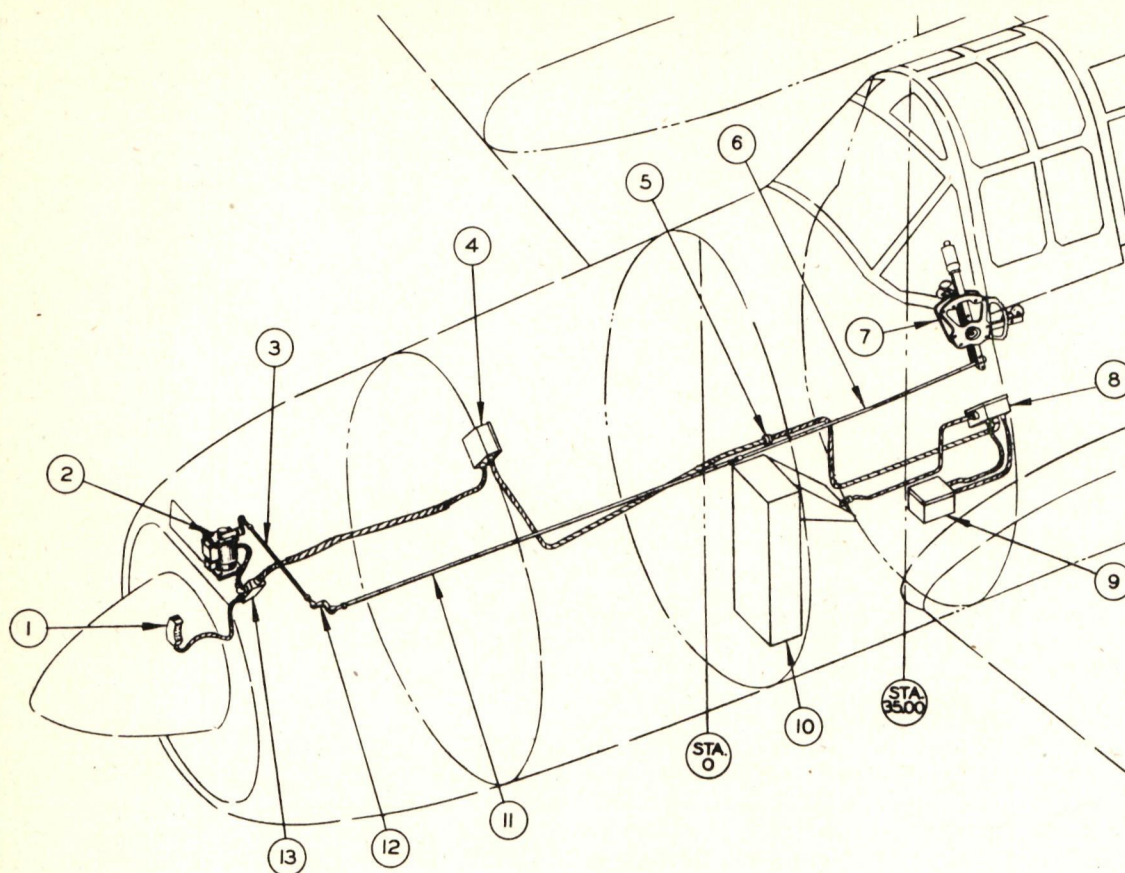


Figure 1-XII - Propeller Units



<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Propeller Motor Brush Assembly	104968-1
2	1	Governor	100008-1
3	1	Governor Control Rod Assembly	1079-D-2-2B-12.75
4	1	Propeller Relay Box	S84-66-588
5	1	Receptacle	AN3100-20-35
6	1	Propeller Rod Assembly (Rear)	S84-52-524-2
7	1	Engine Control Quadrant	S84-52-540
8	1	Propeller Switch Box	S84-66-561 *
9	1	Propeller Filter Box	S84-66-604
10	1	Main Junction Box	S84-66-679
11	1	Propeller Rod Assembly (Front)	S84-52-524-1
12	1	Bell Crank	1057-D-90-1.75 x 2.50
13	1	Governor Junction Box	S84-66-587

* Used on airplanes AAF Serial Nos. 41-18774 through 41-18798. Airplanes 41-18799 and up use propeller switch box S84-66-823.

Figure 2-XII - Propeller Control Installation

From the slip rings, the electrical energy passes through connector leads in the hub, to leads in the speed reducer, and thence to the motor. The motor changes the blade angles through a two-stage, planetary-type speed reducer which drives a master bevel gear. This gear meshes with a bevel gear attached to the shank of each blade. Thus, depending upon the direction of rotation of the motor, the angle of the blades is increased or decreased.

A brake is attached to the front end of the electric motor for the purpose of stopping its rotation when the current is cut off. The brake also provides a definite lock which holds the blades in a fixed position, when no angle change is required.

Switches are provided in the hub end of the power unit to limit the low and high blade angles of the flight range. These switches are cam-operated and are connected to their respective motor leads.

b. Operation of Propeller Circuits.- The Curtiss electric propeller may be operated either manually or automatically by the pilot.

A proportional governor controls the operation of the propeller blade angle change in the "AUTOMATIC" position. The purpose of the governor is to maintain the engine at a set, constant speed by changing the propeller blade angle to correct for varying conditions of operation such as engine power, airplane speed, and air density.

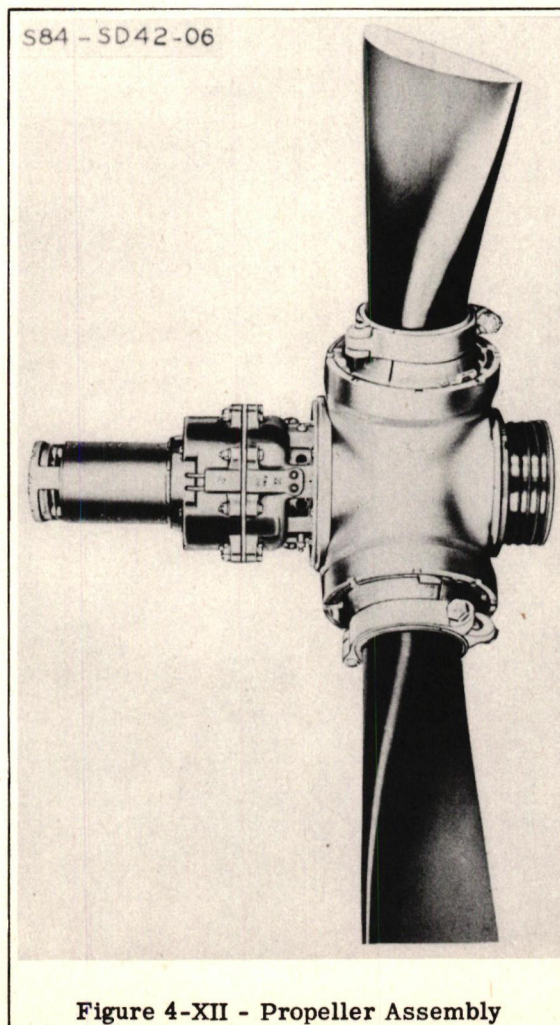


Figure 4-XII - Propeller Assembly

SELECTOR SWITCH CIRCUIT BREAKER

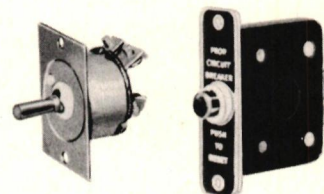


Figure 3-XII - Cockpit Control Switches

This type of control system employs a spring-loaded, centrifugal type governor having an oil servo-operated switch mechanism. The governor is designed to be mounted on the governor drive pad of the engine. The rpm setting of the governor is varied with a cockpit control lever which is connected to the governor by means of push-pull rods and bell cranks. Suitable cockpit switches, a relay wiring, and necessary conduits to the governor, relay, and propeller complete the propeller control system.

To operate the propeller, the battery switch and the propeller circuit breaker must be in the "ON" position. When the engine is running, the generator switch must also be "ON."

(1) Automatic Operation.- To operate the propeller automatically, place the selector switch in "AUTOMATIC" position. Select the desired speed by placing the governor cockpit control lever in the propeller position for the rpm setting desired. Once the control lever is set, the governor will automatically maintain the selected engine speed by switching electrical energy to the pitch-changing motor as required.

Thus, if the engine develops a speed other than the speed selected, the governor switches electrical energy to the propeller motor. The motor, in turn, adjusts the blade angle to correct the off-speed condition.

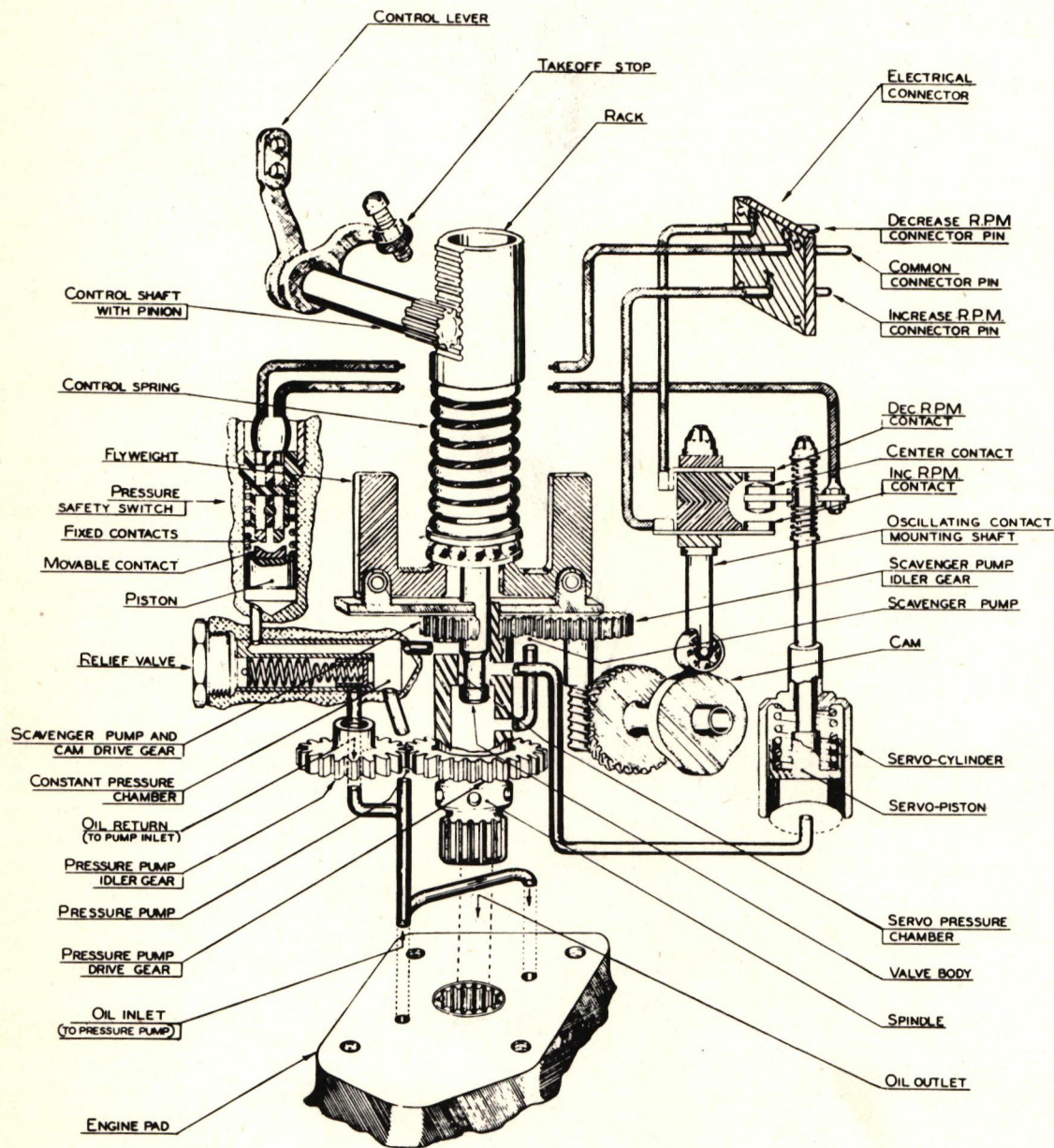


Figure 5-XII - Proportional Governor Schematic

(2) Manual Operation.- To operate the propeller manually, hold the selector switch in the "DECREASE RPM" or "INCREASE RPM" position until the desired blade angle change is obtained. When released, the switch will spring back to the "OFF" position and the brake will hold the blades at the established setting.

c. Operation of Governor.- Basically, the governor is a single pole, double-throw switch, placed in the propeller circuit and operated automatically by the flyweight forces which are affected by variations in governor speed. An oil servo mechanism is employed to provide movement of the center contact of the switch. Oil from the engine oil system is used to operate the servo and is regulated by means of a valve which is linked to the flyweights. The governor has an integral oil pump and relief valve which accurately maintains a constant pressure, regardless of any variations in engine oil pressure. A helical spring counterbalances the flyweight forces so that at governing speed the flyweight valve will supply only enough oil pressure to balance the servo-piston against its spring, thereby holding the center switch contact in the "NEUTRAL" or "OFF" position.

With this arrangement, the flyweight forces reflect any changes in engine speed by corresponding movement of the servo-piston and the center switch contact.

Should the engine speed increase, the flyweights move outward under the additional centrifugal forces, causing the valve to increase the oil pressure to the servo, thereby moving the center switch contact in the upward direction. Should the engine speed decrease, the flyweights move inward, causing the valve to decrease the oil pressure to the servo, and consequently moving the center switch contact downward.

Two contacts, one above and one below the center contact, represent opposite poles of a figurative double-throw switch. The upper contact provides a means for closing the "DECREASE RPM" propeller circuit; the lower contact provides a means for closing the "INCREASE RPM" circuit.

In order to provide for proportional corrections of speed variations within a fine degree of sensitivity, and to provide electrical contact that will effectively make and break the circuit, the "DECREASE RPM" and "INCREASE RPM" contacts are mounted on a shaft which allows these contacts to oscillate up and down within a given range. This movement of the contacts is caused by having the mounting shaft ride on a cam which is geared to the governor spindle.

The "DECREASE RPM" and "INCREASE RPM" contacts are spaced so as to permit them to oscillate by following the movements of the previously mentioned cam without touching the center contact, when it is in the "NEUTRAL" position. Should the engine speed increase or decrease slightly, the center contact will move toward the "DECREASE RPM" or "INCREASE RPM" contact, as the case may be, and it will be touched by this outer contact momentarily each time the cam motion brings the outer contact toward the center contact. Thus, for a slight increase or decrease in speed, the amount of blade angle correction brought about by momentary contact is sufficient to supply the exact correction for off-speed condition. For greater off-speed condition, the center contact will move farther toward either of the oscillating contacts, thereby closing the circuit for a longer period. The period that the contacts remain in touch with each other increases as the off-speed condition increases, until finally the two will be making continuous contact. Thus, when off-speed conditions become excessive, continuous contact is established.

Since the servo mechanism in the governor would cease to operate if a failure should occur in the engine oil supply, an oil pressure safety switch is employed to automatically disconnect the governor from the propeller circuit. In effect, this will cause the propeller blades to remain fixed at the angle they had at the time the oil loss occurred. Opening the automatic control circuit in this manner does not in any way affect the operation of the manual selective control system.

d. Operation of Relay.- A relay is required in the control system of the propeller. In reality, the relay is the heavy duty switching mechanism of the propeller control circuit. Its purpose is to carry the propeller operating current to the pitch change motor during the time that the propeller is operating in "AUTOMATIC" control. A low amperage current, controlled by the governor contacts, energizes one or the other of the relay solenoid coils. These energized coils act upon the armature of the relay which, in turn, causes the heavy relay points to make or break the propeller circuit.

3. Installation of Propeller.

a. Uncrating and Assembly of Blades.- Each propeller is fully assembled, balanced, and tested for proper functioning prior to shipment.

The propeller is shipped with the propeller shaft nut, the front cone, the retaining snap ring, the grease seal and spreader, and the power unit removed. The power gear assembly is attached to the power unit.

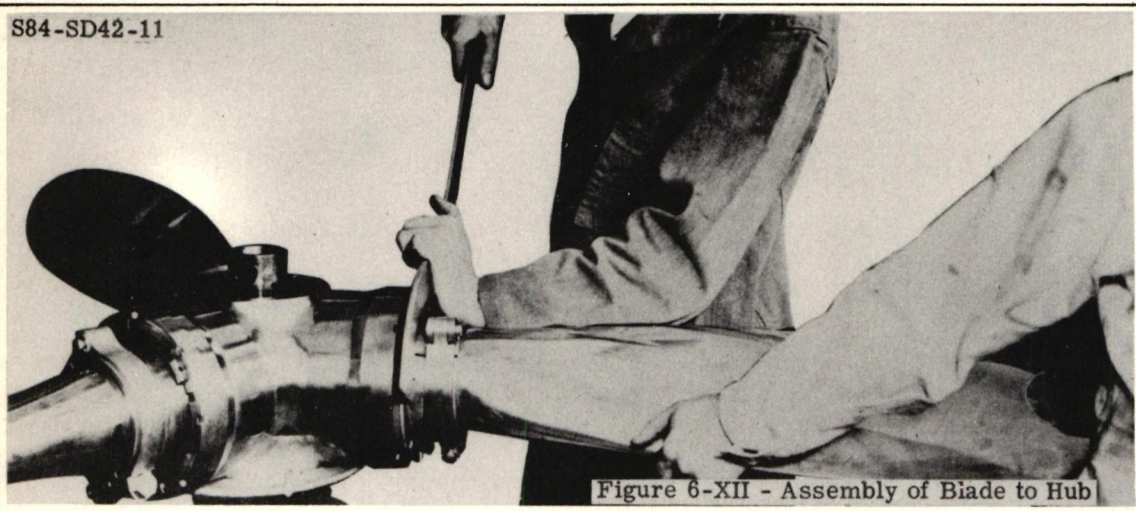


Figure 6-XII - Assembly of Blade to Hub

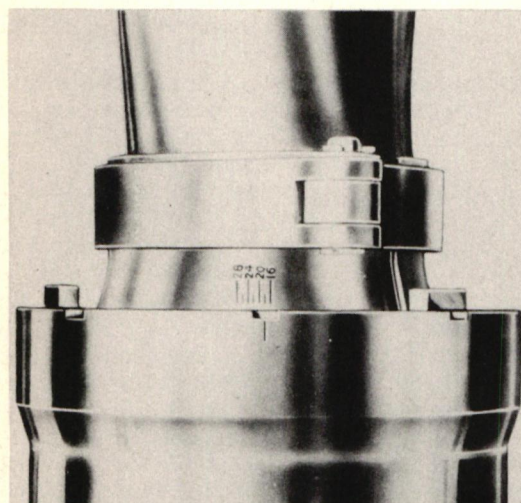


Figure 7-XII - Indexing of Blade

To conserve shipping space, it is sometimes desirable to remove two blade assemblies from the hub. If this has been done, the propeller must be reassembled in the manner described below:

(1) Remove the hub with its one blade from the packing case and place the unit on any clean surface, the slip rings down. Although no table or spindle is necessary, such equipment will facilitate the installation of the blades.

(2) Thoroughly clean the other blade bearing stacks and hub sockets. Coat with light engine oil.

(3) Make sure that the threads of the hub and blade nuts are free from metal chips and other extraneous matter, and that the threads are thoroughly coated with a mixture of 70 percent white lead and 30 percent lubricating oil by volume.

(4) Remove the locking plates which have been temporarily installed on the nuts of the loose blades.

(5) Place the blade gear backlash shims in the bottom of the blade sockets. The chamfered side of the shim must face toward the center of the hub.

(6) Insert each blade in its proper socket. The blade assembly numbers are stamped on the retaining nuts. The hub socket numbers are stamped on the end of each blade barrel.

NOTE: In the event that the relationship of the blade gear has been altered, (i.e. blade clamp loosened) proceed as follows:

Screw each blade nut into the hub until one-half of the threads are engaged. Slide each blade assembly in and out several times and finally pull it out sharply against the blade nut.

Insert an aluminum wedge between the end of the blade and the hub boss in the bottom of the blade socket. Tighten the blade nut snugly. Loosen the blade clamp and further tighten the blade nut. Tighten the blade clamp, back the blade nut off slightly, and remove the wedge while holding the blade out by hand. Then screw the blade nut into the hub. While exerting an outward pull on the blade, tighten the blade nut with the spanner wrench provided and a ten-pound brass hammer (or equivalent) until the paint marks on the nut and hub slots line up. If there are no paint marks, tighten the nut until it is barely possible to rotate the blade by hand.

To index the blade to the blade gear, proceed as follows:

(a) On gears having eighteen teeth, set the center of the eighth tooth from the trailing edge of each blade gear in line with the center line mark on each hub barrel.

(b) Set the power unit at the low blade angle setting (as described in paragraph c (1) following) and index the power gear for 25 degrees.

(c) Bolt the unit to the hub; then increase the blade angle a few degrees by energizing the unit through the slip rings. Use a brush assembly to carry the current to the slip rings, thus avoiding pitting of the slip rings.

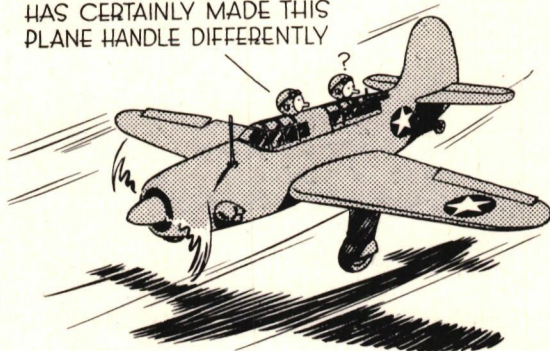
(d) Then decrease the blade angle until the low limit switch cuts out.

(e) This setting is 25 degrees; therefore adjust the blade angles by loosening the clamps and rotating the blades in the blade gear sleeve to 25 degrees. This relationship between the blade and the blade gear should not be altered. Set the clamp bolts on propellers using anti-icing equipment at a negative angle of 27.5 degrees. If no anti-icing equipment is used, the bolt should be parallel to the blade angle at the 42-inch station and the head of the bolt should face the leading edge of the blade. Pull out on the blade and tighten the nut on the clamp bolt, making certain that the shoulder of the clamp is pressing snugly against the shoulder of the gear sleeve. The nut should be tightened approximately 75 to 85 foot-pounds torque. The head of the clevis pin should face the center of the hub.

(f) Remove the power unit; then set the power gear to the desired low blade angle (21.7 degrees) by placing the power gear on the splined shaft, having the desired low blade mark in line with the master spline.

(g) Set blades at correct low angle (21.7 degrees) by setting proper marks on the blade gear sleeve opposite index marks on blade sockets; then reassemble power unit to hub and check for correct blade angle settings.

INDEXING THE PROPELLER
HAS CERTAINLY MADE THIS
PLANE HANDLE DIFFERENTLY



(7) Screw each blade nut into the hub. While exerting an outward pull on the blade, tighten the blade nut with the spanner wrench provided and a ten-pound brass hammer (or equivalent) until the paint marks on the nut and hub slots line up. If there are no paint marks, tighten the nut until it is barely possible to rotate the blade by hand.

(8) Install the lock and safety wire the attaching screw.

(9) Each propeller shipped disassembled is accurately balanced prior to shipment. A tag certifying this fact is attached to every unit, and balancing is unnecessary if blade assemblies

are properly installed in their respective sockets. If the tag is missing or if there is any doubt as to the condition of the propeller, it should be balanced prior to installation merely as a precautionary measure.

(10) Install and secure the spinner bulkhead to the spinner mount on the hub.

(11) Install the slinger tubes from the slinger ring to the blade collector cup.

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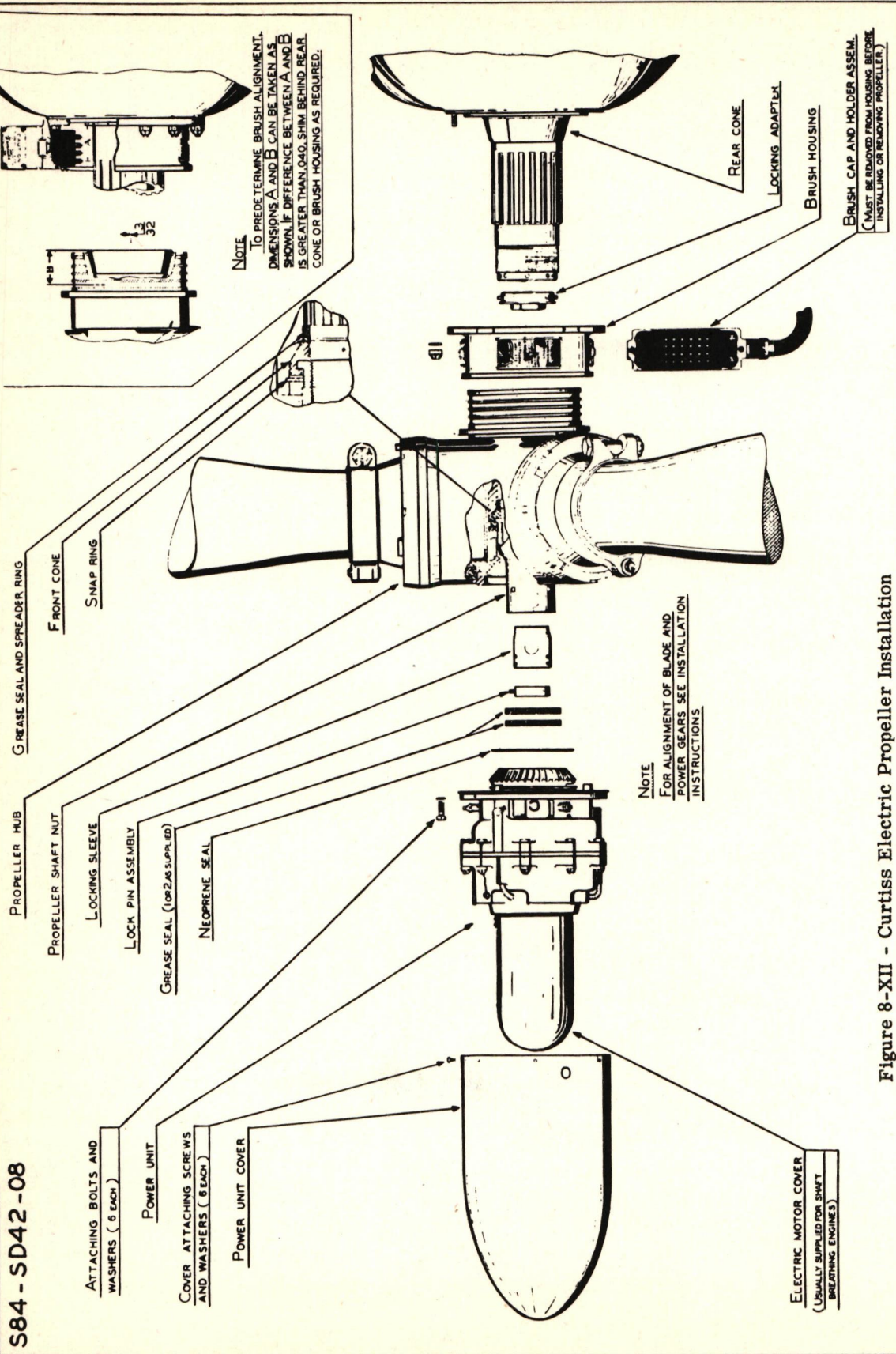


Figure 8-XII - Curtiss Electric Propeller Installation

b. Installation of Propeller.-

(1) Check thrust nut on engine for tightness; clean shaft threads and splines thoroughly. Remove all nicks, burs, and galls from the shaft and face of the thrust nut. Care should be taken to note that the threads on the shaft are not pulled.

(2) Remove nuts (and spacers or spacer ring, if provided) from brush housing mounting studs on nose of engine and place brush housing on studs. Replace, tighten, and secure nuts.

NOTE: Except for the purpose of measuring for brush location as described below, the brush assembly must be left out of the housing until the propeller has been installed.

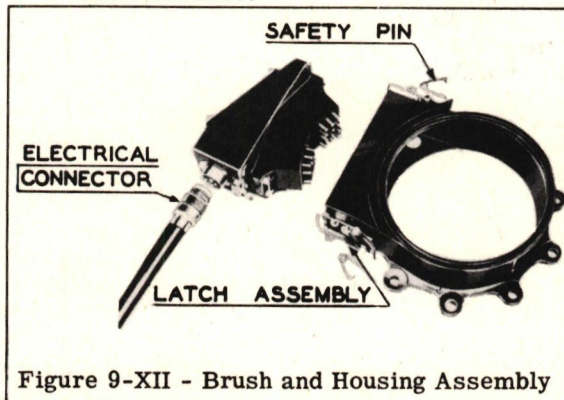


Figure 9-XII - Brush and Housing Assembly

(3) In order to predetermine the location of the brush contact on the slip rings, it is necessary to take the following measurements. Measure the distance "A" between the face of the thrust nut and the center of the forward brush, and the distance "B" between the center of the front slip ring and the rear cone, with the rear cone being held firmly in the hub. If the difference between the two measurements is greater than .040 inch, shim behind the rear cone or the brush housing as required. For distances "A" and "B," refer to figure 8-XII, "Installation."

(4) Install the rear cone on the shaft.

(5) Place the propeller shaft locking adapter in the end of the shaft.

(6) Rotate each blade until the gear teeth are down behind the bulkhead of the hub, to allow enough clearance for the front cone and nut to be installed.

(7) Clean thoroughly and coat the threads of the propeller shaft and propeller shaft nut with a mixture of 70 percent white lead and 30 percent lubricating oil by volume. Apply a light coating of engine lubricating oil to the splines. The rear cone should be left dry.

(8) To avoid damaging the propeller shaft threads while installing the propeller, it is desirable to use a thread protector. Proceed as follows:

(a) Screw the thread protector on the shaft, tightening only by hand.

(b) Being careful not to damage the shaft or rear cone seat, locate and slide propeller half-way back on the shaft.

(c) Remove the thread protector.

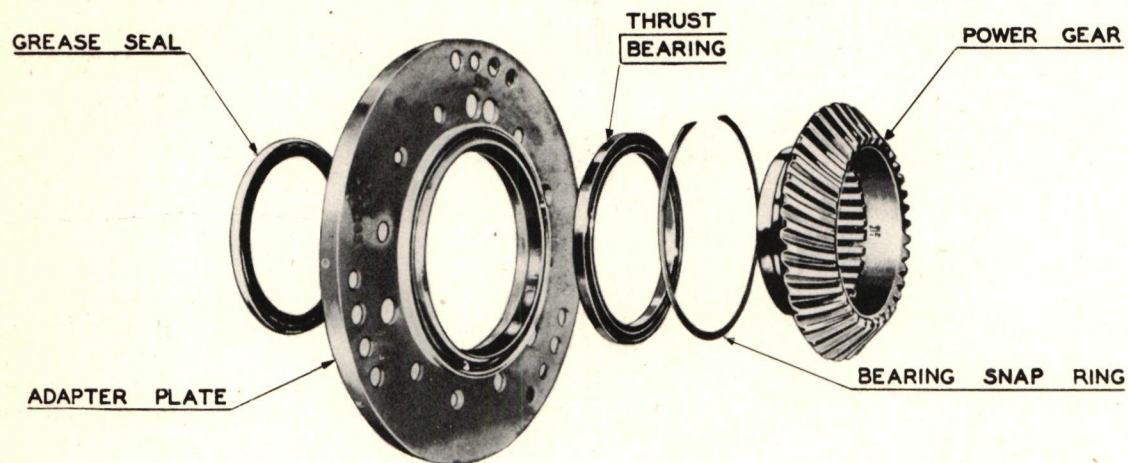
(d) Install grease seal and spreader.

(e) Install the nut, front cone, and retaining snap ring. New cones may come in one piece, in which case it will be necessary to saw the halves apart and carefully remove the metal left in the split.

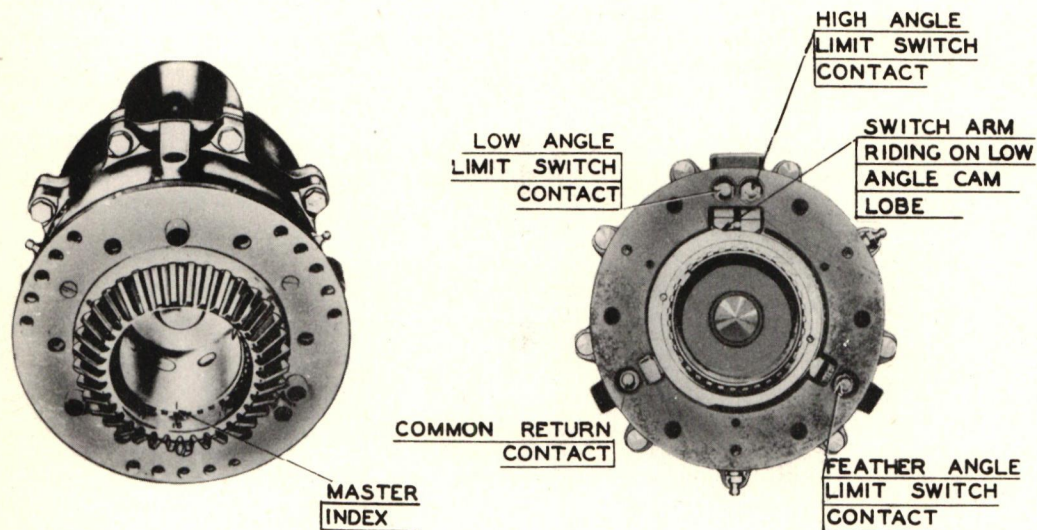
(f) Slide the propeller back on the shaft and carefully start the nut on the threads of the propeller shaft. Tighten nut with a force of two hundred and fifty to three hundred pounds on a three and one-half foot bar placed through the holes in the nut. Hammering on the bar is unnecessary and should be avoided.

NOTE: If a thread protector is not available, extreme caution should be taken to prevent damage to the cone seats and shaft threads during installation.

(9) To make a final check of brush alignment on the slip rings, apply a light coating of



POWER GEAR ASSEMBLY



INDEXING OF POWER GEAR

(R.H. PROPELLER)
LIMIT SWITCHES

Figure 10-XII - Power Unit Details

Prussian Blue to the end of the slip ring brushes and place the assembly in the housing. Rotate the propeller back and forth slightly and remove the brush assembly. The brush track should be in the approximate center of the slip rings and not closer than .020 inch to the slip ring insulators. Shim behind either rear cone or brush housing to obtain proper alignment. When the alignment is satisfactory, clean the brushes and slip rings and install brush assembly. Lock the latches with safety pins.

(10) Fit the locking sleeve to the adapter inside the propeller shaft nut, so that a lock pin hole lines up with a hole in the nut. If the holes do not line up, on the first application, remove the locking sleeve and change its position on the adapter until the holes are in alignment. Place lock pin assembly in position and release the lock pin. Note that it passes through both the locking sleeve and propeller shaft nut.

(11) Install the anti-icing fluid line into the slinger ring on the propeller hub.

c. Installation of Power Unit.

(1) Before installing the power unit, check to see that the low limit switch arm is just riding on the low limit segment of the cam. To make this check, remove the snap ring, the three retaining screws, and power gear assembly.

NOTE: Whenever the power unit is operated and the electrical contact is not made through the slip rings, the mechanical stop must be removed to eliminate the possibility of damaging the speed reducer housing.

The cam may be rotated to the correct position by introducing a current through the two proper contacts on the face of the power unit. To prevent unnecessary burning of the contact points, the leads should be touched to the side of the contact.

NOTE: The power unit splined shaft has a master, or index spline, which is indicated by an etched mark on its inner diameter. The power gear is marked in increments of one degree. Etched lines or a decalcomania on the blade gear sleeve indicate the blade angle when aligned with the index on the front of each blade socket. The blade angles of propellers used on the A-25A Airplanes are measured at the 42-inch station.

(2) Replace the power gear assembly, having the master spline in line with the mark on the power gear indicating the desired "LOW" blade angle. Replace the three attaching screws and snap ring.

(3) Rotate each blade assembly until the index on the blade gear sleeve indicates the desired "LOW" blade angle 21.7 degree (same angle indexing as the power gear).

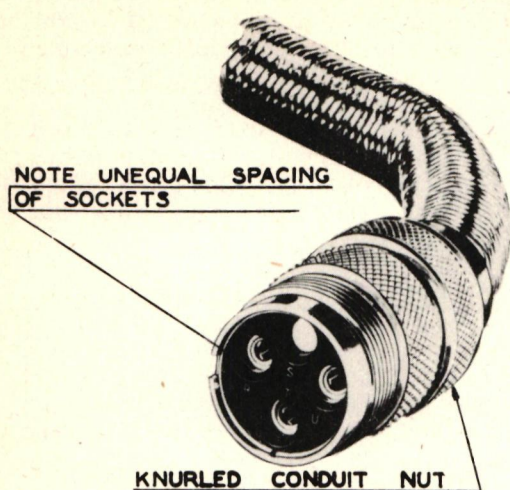
(4) Coat the gears with AAF-3581 grade AA (low temperature) grease. The power gear pre-load is correctly adjusted at the factory. If the propeller assembly has not been shipped from the factory, it is advisable to check the pre-load in the following manner.

Remove the neoprene ring seal from the adapter plate. Place the power gear assembly on the hub, with the propeller in a horizontal position and bolt the assembly tightly in place, using the attaching bolts with spacers under them. Back off the bolts and without moving the adapter plate, measure the clearance between the face of the hub and the bottom of the adapter plate. This clearance should be from .002 inch to .005 inch.

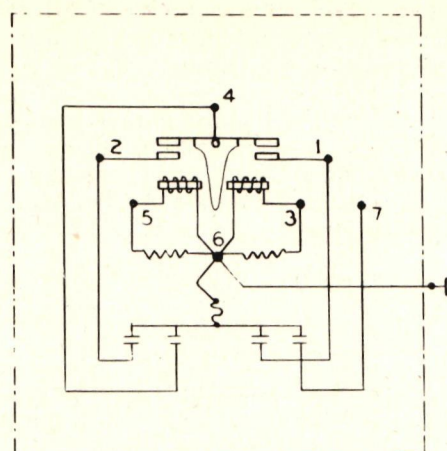
To obtain this clearance, remove or add shim laminations between the power gear and thrust bearing.

(5) Make certain that the breather section grease seal is in place in the bottom of the power gear, and replace the neoprene ring seal on the adapter plate.

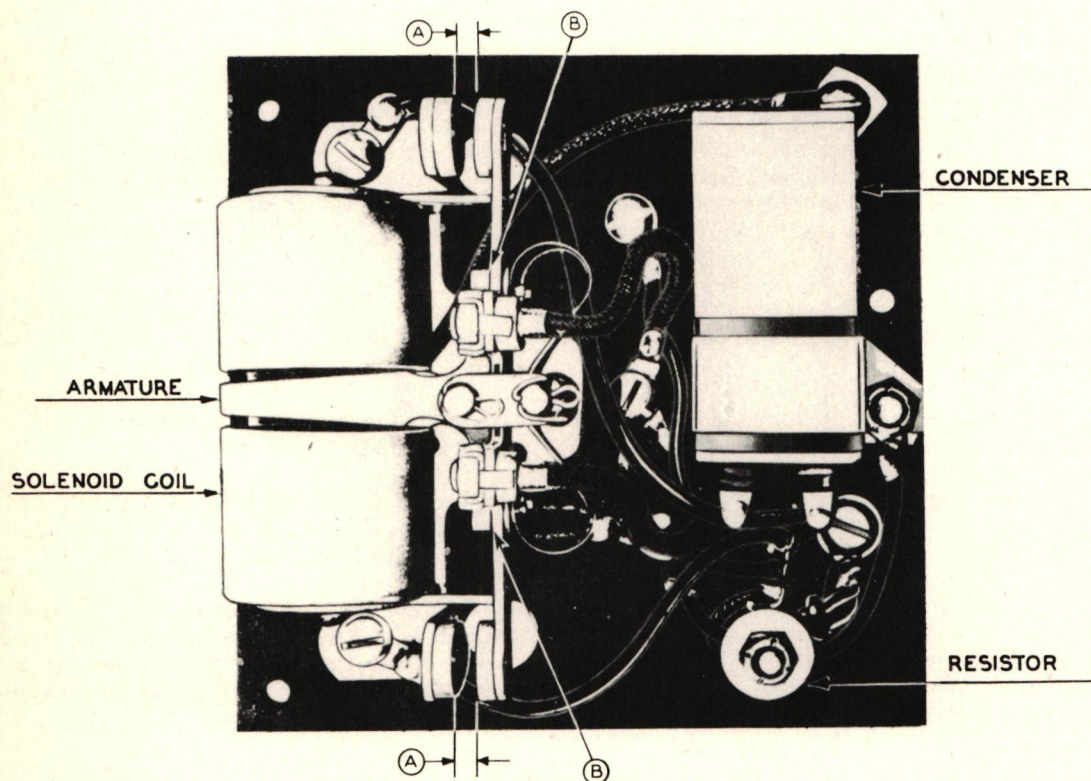
(6) Clean the contact points on the face of the hub and power unit. Align the contact points and bolt holes of the power unit and hub, and place the power unit on the hub. Push the unit hard against the hub so that the power gear meshes with the blade gears. Secure the unit with the six attaching bolts and lock wire them.



ELECTRICAL CONNECTOR PLUG



RELAY WIRING DIAGRAM



RELAY ASSEMBLY

Figure 11-XII - Electrical Units

(7) Install the mechanical stop and safety. The zero mark on the mechanical stop must be adjacent to the zero mark on the speed reducer housing.

d. Installation of Relay.-

(1) Connect the conduit from the controls to the relay, and from governor junction box to the electrical connector socket of the brush block. The threads should be coated with anti-seize compound. Make certain that the knurled conduit nut, locking the ferrule, is backed off at least one turn to allow free rotation of the electrical connector plug. Extreme care will prevent cross threading or forcing the contact pins into an incorrect position, since the pins are unequally spaced and will not easily go together incorrectly. (See figure 11-XII, "Electrical Connector Plug.")

Install the relay in the relay box. The relay is held in position in the relay box by three screws, secured by self-locking nuts.

(2) Tighten the plain and self-locking nut on the No. 6 terminal jumper; attach and secure the wire terminals to the propeller relay studs, according to the wiring diagram. Make absolutely sure that the wire connections are correctly made and will not cause any possible short circuits. After all the connections have been made, fasten the relay cover to the relay box with four screws.

e. Installation of Governor.-

NOTE: The governor should not be installed on a new or overhauled engine that has been in storage until after a preliminary engine run as follows:

Engines removed from "OLD" type storage conforming to Specification No. AN9505 (now obsolete) should be run one-half hour, and the oil system drained and oil strainers cleaned, before the governor is installed.

Engines removed from "NEW" type storage conforming to Specification No. AN-F-E-568 should be run one-fourth hour and the oil strainers cleaned, before the governor is installed.

In either case, a suitable cover and gasket must be installed on the governor to prevent escape of oil. Also the conduit from the engine front cover junction box to the governor, and the control rod from the governor to the forward propeller control bell crank must be removed before the initial engine run.

The above procedure is necessary to prevent anti-rust compound from collecting in the governor, and thereby causing sluggish action.

Obtain the low blade angle prior to starting the engine by holding the selector switch in the "DECREASE RPM" position momentarily, and then in the "INCREASE RPM" position until the propeller stops changing blade angle.

(1) Make certain the engine pad and base of the governor are clean. Install the gasket and the governor, being careful not to mesh the splines. The gasket supplied with the governor should be installed dry. Safety wire the castle nuts and attach the controls.

(2) Obtain a minimum of 1/8-inch spring-back of the cockpit control lever when the stop arm on top of the governor is fully against the stop. Adjustments may be made on the push-pull rod located directly behind the governor, as shown on drawing No. S84-SD42-12. Do not touch the adjustment of the governor take-off stop screw. This was properly adjusted when the governor was calibrated and should not be changed.

(3) To install the electrical connector plug of the conduit from the governor junction box to the electrical connector of the governor, first coat the threads with anti-seize compound. Make certain that the knurled conduit nut, locking the ferrule, is backed off at least one turn, to allow free rotation of the electrical connector plug. Extreme care will prevent cross threading or forcing the contact pins into an incorrect position since the pins are unequally spaced and will not easily go together incorrectly. (See figure 11-XII "Electrical Connector Plug.")

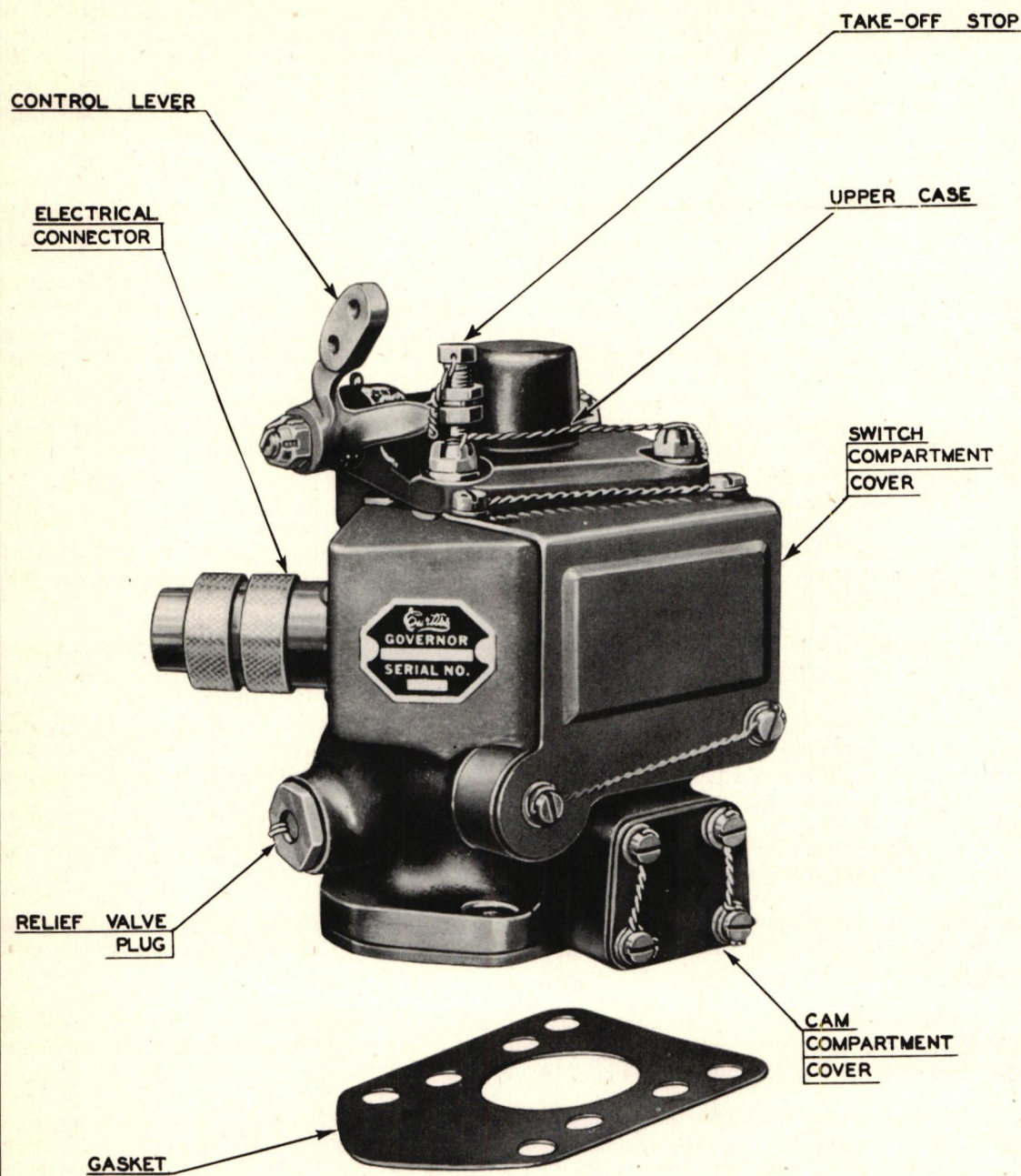


Figure 12-XII - Proportional Governor

f. Operation and Installation Checks.-

(1) Completely fill the hub with low temperature grease, Specification No. AC-3581 by using a pressure gun on the grease fittings located on the rear speed reducer housing just forward of front hub face. A solid flow of grease from the relief fitting will indicate that the hub is full.

(2) The operation test should be made during the engine run-up. First, with the battery and generator switches and the circuit breaker "ON," the selector switch in "AUTOMATIC," the mixture control in "AUTOMATIC RICH," and the propeller control lever in the "TAKE-OFF RPM" position, open the throttle until the engine is turning approximately 1200 rpm.

Then hold the selector switch in the "DECREASE RPM" position until a decrease of approximately 200 rpm in engine speed is noted.

Now hold the selector switch in the "INCREASE RPM" position until the original engine speed is resumed. These tests show that the pitch-changing mechanism is working properly.

(3) Next, to check the automatic operation of the propeller, place the selector switch in "AUTOMATIC" and see that the governor cockpit control lever is in "TAKE-OFF RPM" position. Then open the throttle until the tachometer registers approximately 2000 rpm. Pull the governor cockpit control lever towards the "DECREASE RPM" position until a reduction of not more than 200 rpm is noted. At this rpm, the propeller should hold the engine at a steady speed without surges or other irregularities.

Return the governor cockpit control lever to the "TAKE-OFF RPM" setting. The engine should resume its original speed. Cool and stop engine in normal manner.

g. Installation of Spinner.-

(1) Attach spinner support to the adapter plate and secure the bolts.

(2) Install the spinner. The spinner holes are numbered to correspond to propeller blade numbers.

(3) Secure the spinner to the spinner bulkhead and safety the attaching bolts.

4. Removal of Propeller and Governor.

a. Removal of Propeller.-

(1) Run the propeller to the "LOW" blade angle setting.

(2) Remove the spinner.

(3) Release the two latches that hold the slip ring brush holder assembly to the housing and remove the assembly. Removal is necessary because damage will occur if the propeller is removed with the brushes in position.

(4) Remove the anti-icing slinger supply tubes.

(5) Remove the spinner support from the adapter plate.

(6) Remove the lock wire and power unit attaching bolts from the power unit; then remove the power unit. Place it in a safe place, free from dust and dirt.

(7) Rotate each blade until the blade gear teeth are down behind the bulkhead of the hub.

(8) Remove the lock pin assembly and the locking sleeve from the propeller shaft nut, then loosen the nut, using a force of 250 to 300 pounds on the end of a 3-1/2 foot bar. Do not hammer on the bar. Attach the sling and hoist (or support the propeller if a hoist is not available) and remove the snap ring front cone, and propeller shaft retaining nut.

- (9) Remove the grease seal and spreader from the hub and install a thread protector.
- (10) Slide the propeller off the shaft, being careful not to damage the rear cone seat or the shaft.

- (11) Remove the spinner bulkhead from the hub assembly.

NOTE: If a thread protector is not available, extreme caution should be taken to avoid damaging the rear cone seat or the shaft threads during removal.

- (12) Place the propeller on a smooth, clean surface, slip rings down. Although no table or spindle is necessary, such equipment will facilitate the removal of the blades.

- (13) Remove the rear cone and any shims that may have been installed at assembly.

b. Removal of Governor.-

- (1) Disconnect the control rod from the governor.
- (2) Disconnect the conduit and wire connections by loosening the conduit nut, and then unscrewing the electrical connector plug.
- (3) Remove lock wire and nuts which attach governor to engine drive pad studs.
- (4) Remove governor and gasket; cover the engine drive pad to prevent entrance of dirt or other extraneous materials.

c. Removal of Blades from Hub.-

- (1) Remove the anti-icing tubes from the slinger assembly.
- (2) Remove the locks from the blade nuts, marking the location of each on the hub and the nut with paint. Unscrew the blade retaining nuts from their sockets.
- (3) Remove each blade from its socket and place the blade on a clean assembly table with the bearings projecting beyond the edge.
- (4) Note and record the number stamped on the respective blade nuts and hub barrels, also the serial number on each blade. Although these assemblies are interchangeable, they must be kept in their respective positions in the hub to prevent having to re-balance the propeller.
- (5) Remove all excess grease from the hub, blade gears, and blade bearings.

5. Maintenance.

a. Servicing Daily and at 25 Hours.-

(1) Blades.-

(a) Thoroughly clean and visually inspect blades for damage or defects that may have occurred during previous operation. The blades are to be cleaned with a light lubricating oil and their inspection should include a careful check of the surfaces for damage such as bends, cracks, dents, and nicks. The full length of the leading and trailing edges as well as any dents or scars on the blade surface should be carefully examined for cracks. Each questionable scratch should be carefully examined to determine whether it is a scratch or crack. Raised edges of scratches, nicks, etc., which are likely to induce cracking, may be dressed off with a handstone or emery cloth.

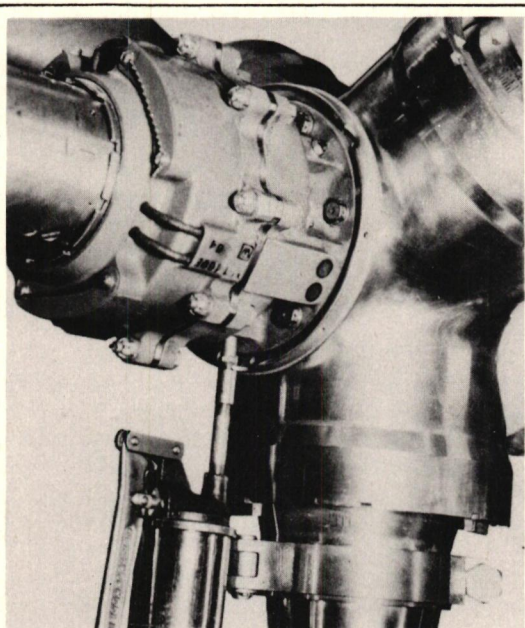
(b) Damaged blades should be repaired only by activities having the proper equipment for the repair required. For other than field repairs, this should include equipment for the complete inspection of blades after repair, and also personnel trained in the proper technique for handling this type of work, so as to assure a high quality of workmanship and a satisfactory repair.

NOTE: Refer to "OVERHAUL" for care of blades at overhaul and repair of damaged blades.

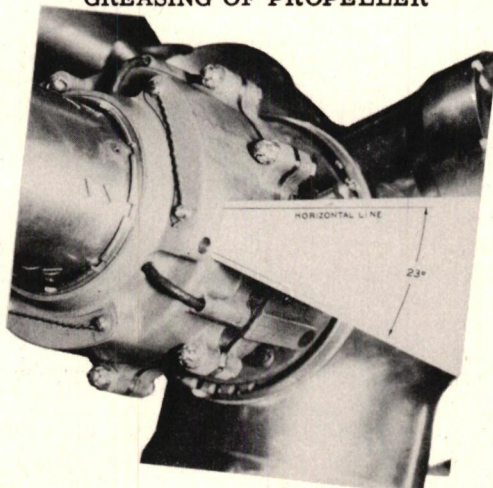
(2) **Controls.**- Visually inspect the condition of all flexible propeller conduits where possible damage may occur. Any foreign matter that may accumulate on the conduit should be wiped off. Visually inspect condition of control rods in engine nacelle.

(3) **Operational Check.**- The operation test should be made during the engine run-up. First, with the battery and generator switches and the circuit breaker "ON," the selector switch in "AUTOMATIC," the mixture control in "AUTOMATIC RICH," and the governor cockpit control in the "TAKE-OFF RPM" position, open the throttle until the engine is turning approximately 1000 rpm.

Then hold the selector switch in the "DECREASE RPM" position until a decrease of approximately 200 rpm in the engine speed is noted.



GREASING OF PROPELLER



CHECKING SPEED REDUCER
OIL LEVEL
(15° GROUND LINE)

Figure 13-XII - Lubrication Details

Now hold the selector switch in the "INCREASE RPM" position until the original engine speed is resumed. These tests show that the pitch changing mechanism is working properly.

Next, to check the automatic operation of the propeller, place the selector switch in "AUTOMATIC" and see that the governor cockpit control lever is in "TAKE-OFF RPM" position. Then open the throttle until the tachometer registers approximately 2000 rpm. Pull the governor cockpit control lever towards the "DECREASE RPM" position until a reduction of not more than 200 rpm is noted. At this rpm, the propeller should hold the engine at a steady speed without surges or other irregularities.

Return the governor cockpit control lever to the "TAKE-OFF RPM" setting. The engine should resume its original speed. Cool and stop the engine in normal manner.

b. Servicing at 50 Hours (to include all daily and 25-hour checks).-

(1) Remove the brush assembly from the housing by releasing the two latches. Wipe the slip rings by holding a cloth against them while the propeller is being rotated and inspect the slip rings for wear. Clean oil and carbon dust from the brush holder and brushes with a clean dry rag or brush and make certain that the brushes slide freely in the holder. The brushes are inscribed on the side with an arrow pointing toward the end of the brush. When the point of wear of a brush reaches the tip of the arrow or beyond, the brush must be replaced.

(2) Examine electrical connectors, noting the condition of the sockets and pins. Coat the housing threads with anti-seize compound before replacement.

(3) Inspect the governor cockpit control levers to determine that they have at least one eighth-inch spring-back from the full forward position, as an assurance that the governor con-

trol is fully against the stop, which is set for take-off rpm. Adjust control rods, if necessary, but do not adjust the stop screw on the governor since it is already set to provide take-off rpm.

(4) Check the oil level in the speed reducer by removing the oil filler plug located near the front of the housing. The oil should be at the plug opening when the propeller is rotated until the opening is approximately 23 degrees below the horizontal plane, with the airplane at a ground angle of 15 degrees and approximately 8 degrees below horizontal when the airplane is level. Add oil conforming to Specification No. AAF-3563 as required; (Curtiss Speed Reducer Oil No. 2 conforms to this specification).

Lubricate the hub with low temperature grease, Specification No. AAF-3581, grade AA, by using a pressure gun on the grease fittings located on the speed reducer housing just forward of front hub face, until the hub is completely filled. A solid flow of grease from the relief fitting will indicate that the hub is full.

c. Servicing at 100 Hours (to include all daily, 25-hour, and 50-hour checks).-

(1) Remove the switch compartment cover from the governor. Inspect the condition of the contacts. See that the wire leads are securely attached. Thoroughly clean contact assemblies with cleaning solvent or unleaded gasoline and remove any oil that may have accumulated in the switch compartment.

The contact points will not require dressing, although their contacting surfaces should be cleaned with crocus cloth or fine sandpaper. Place not more than one drop of light lubricating oil on the upper end of the shaft which supports the center contact assembly. Replace cover.

(2) Relay.- Partially remove relay from its box for inspection. Inspect for proper mating of contact points and sufficient contact point pressure.

There should be no unrestricted movement of the armature or transverse arms. Movement of the armature from the neutral position should be immediately opposed by pressure from the lower transverse arm spring. With the armature in neutral position, the lower transverse arm should seat at both edges of the armature T head, and at the same time rest against both coil bracket extensions. If the arm is bent at one end to center the armature, it must also be bent in the opposite direction at the other end, in order to maintain contact at all four points.

The four self-aligning bushings which locate the springs in the transverse cross arms should not extend through the arms so as to touch the face of the armature head.

Then in the neutral position, the armature should be aligned so that the gap (arrow "A," picture titled "Relay Assembly"), between the movable and fixed contracts, is .080 inch to .100 inch.

This adjustment is made by bending the upper transverse arm and/or the fixed contact supports.

Then the armature stem is held solidly against the coil housing; there should be a gap of at least .008 inch between the outer edge of the armature T head and the upper transverse arm. This gap will be on the side of the closed contact (arrow "B" on picture titled "Relay Assembly") in either direction. In order to obtain this gap, and at the same time maintain the clearance required in the above paragraph, it may be necessary to alter some of the previously made adjustments.

The Elkonite relay points are very hard and become discolored after continued service. The contact surfaces take on a charred appearance and develop very fine pit marks. These indications are normal characteristics of this material and do not affect in any way the operation of the relay as long as satisfactory contact pressure is maintained. The Elkonite points should not be dressed or polished as this only decreases the life of the contact and does not improve the operation.

The contact point material, as attached to the contact arm, is 1/8-inch thick. If this material becomes less than 3/32-inch in thickness at any point, due to wear or burning, the contact should be replaced. It should be noted that the surface of the movable contact is slightly

rounded when new. The wearing off of the rounded portion does not impair operation. The purpose of this rounded portion is to facilitate the seating of the two contacts when first put into operation.

Satisfactory closing of the contact should be made within 10 to 16 volts.

In the event that radio interference caused by the propeller is experienced, it will be desirable to test each condenser as follows:

Set an ohmmeter for high resistance range. Place one lead from the ohmmeter to the condenser case, the other lead to the contact. The ohmmeter will give a short, quick response, and at the same time the condenser will have received a slight charge. Immediately reverse the leads. This time the needle should again respond, and the extent of the deflection should be a little greater than the first, due to the slight additional charge stored up in the condenser.

A full and permanent deflection of the ohmmeter indicates that the condenser is shorted and the condenser should therefore be replaced. No motion of the needle is an indication that the condenser fuse is burned out and the assembly must be replaced. Before replacement, however, make certain that a satisfactory ohmmeter resistance has been selected.

Examine resistor for breaks in the porcelain casing. If the porcelain is badly broken, it is desirable to replace the unit. The resistance rating on the 24-volt relay is 800 ohms each side of center connection.

Make sure the armature floats freely on its pivot pin. Lubricate if necessary with a small quantity of oil or semi-fluid lubricant.

Examine all terminal and wire connections, making sure that one of them is loose and that there is no possibility of the terminals touching each other. Replace relay in box.

(3) Inspection of Motor Housing.- Remove the motor cover. Inspect the general condition of the electric motor housing.

(4) Magnetic Brake.-

(a) Check the brake clearance by using a feeler gage between the inner ring of the end shield assembly and the rear brake plate. This clearance indicates the brake gap. It should be from .010 inch to .020 inch, and may be adjusted in the following manner:

1. Remove the thrust plate assembly.
2. Remove the three elastic nuts from the bolts on the thrust plate assembly and remove the front brake plate.
3. Add or remove shims under the front brake plate as necessary, to obtain the proper clearance.
4. Replace and secure the shims and the front brake plate.
5. Install and tighten the thrust plate assembly.
6. Again check the brake clearance.

(b) When the proper clearance is obtained, install and safety wire the thrust plate assembly lock. The thrust plate assembly should always be screwed in tight, and should never be backed off to align the lock or to adjust the brake clearance.

NOTE: In the event it becomes necessary to adjust the brake hub, proceed in the following manner:

Measure the hub clearance. This is the clearance between the hub and the rear brake plate when the brake is fully assembled. However, since this measurement is rather difficult to obtain when the brake is assembled, it may be taken with the thrust plate assembly removed,

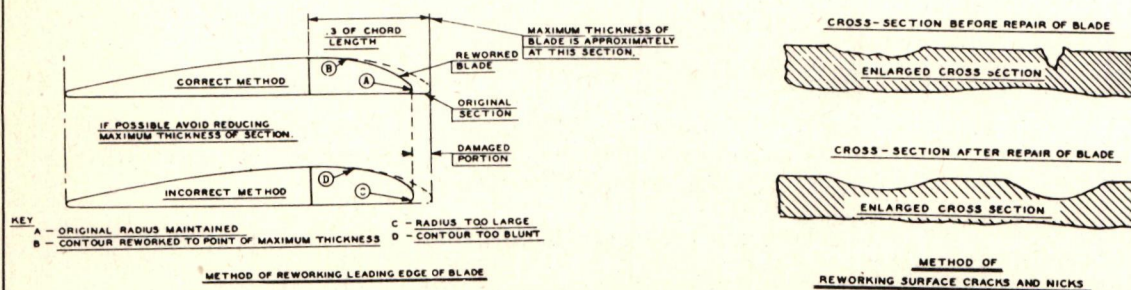
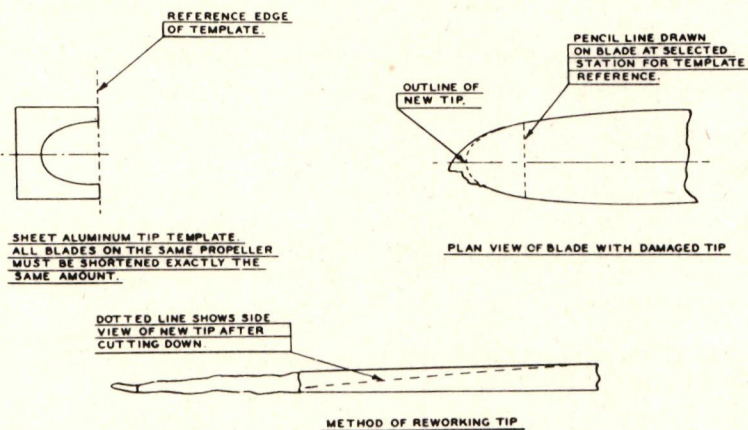
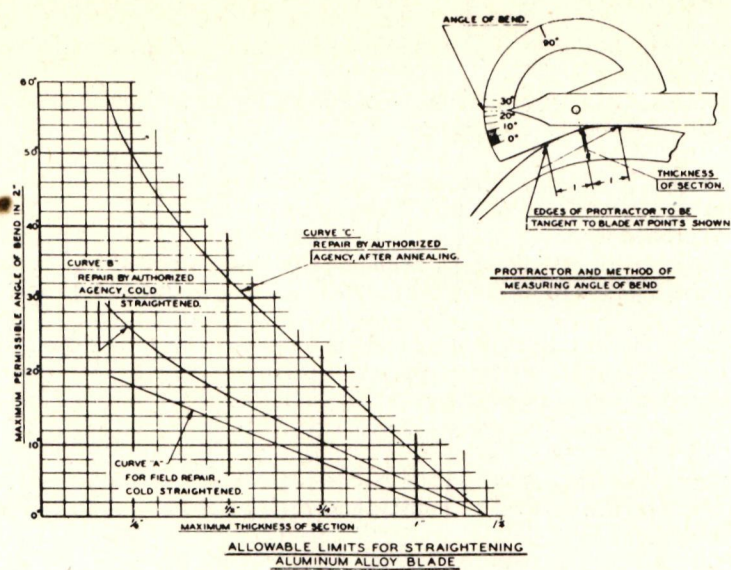


Figure 14-XII - Repair Data

by measuring the clearance between the inner ring of the end shield assembly housing and the rear brake plate, with a feeler gage. This clearance should be from .035 inch. To make this adjustment, proceed as follows:

1. Remove the thrust plate assembly lock. Using a thrust plate wrench, unscrew the thrust plate assembly.
2. Remove the brake disk.
3. Remove the cotter key from the shaft nut and, while holding the brake hub with a hub holder, remove the shaft nut.
4. Remove the hub with a hub puller. Remove the hub locating key from the shaft.
5. Lift off the top spacer and add or remove shim laminations to obtain the proper adjustment.
6. Replace in the reverse order. When the proper clearance is obtained, cotter the shaft nut.
7. After inspection, replace the motor cover and lock wire.

d. Overhaul.-

(1) Care of Blades at Overhaul.-

(a) Nicks and dents on the leading edge of the blades shall be blended into the contour with smooth curves faired longitudinally, by using a riffle file and crocus cloth. Scratches, nicks, raised edges, etc., on the face of the blade shall be removed with a suitable riffle file and sandpaper, after which the surface involved will be smoothly finished with 00 sandpaper. With the exception of cracks, it is not necessary to completely saucer out all of a comparatively deep defect. It will be sufficient to round out the edges and smooth the surface inside the defect and locally etch the spot to make certain there are no cracks, sharp edges, or doubled back material. It is absolutely essential that no unnecessary removal of metal take place, although peening metal back in place is not desirable.

(b) Scratches and suspected cracks may be given a local etch and then examined with a magnifying glass. To locally etch a portion of the blade, use a 20 percent aqueous solution of caustic soda 71 degrees to 82 degrees C (160 degrees - 180 degrees F). First clean off the area with fine sandpaper; then apply the etching solution with a small swab. When the area has become well darkened, wipe the area off thoroughly with a clean damp cloth. Too much water tends to remove the solution from the defect, thereby spoiling the check. If a crack or any other defect extending into the metal is present, it will appear as a dark line. Under a magnifying glass, small bubbles may be seen forming in the mark. A transverse crack of any size is cause for rejection. After etching, the blades shall be thoroughly cleaned with a solution of approximately 20 percent nitric acid and 80 percent water.

Care should be taken not to etch the shank portion. This is important, since the etching process removes metal to a degree which at times may be sufficient to warrant rejection.

The shank fillets and the front half of the camber side of the blade are the most critical portions. Etch locally two areas about an inch and a half in diameter on the shank portions, in line with the leading and trailing edges, just inside the outer edges of the blade gear sleeve. Examine with a magnifying glass for circumferential cracks. Any crack in this portion is cause for rejection.

An alternate method, if considered feasible, is to use gasoline and oil. Wash the blades off with gasoline and rub them down with oil. All excess oil must be wiped off the blades. Any crack or defect which is present will appear as a dark line on the surface of the blade.

(2) Repair of Damaged Propeller Blades.-

(a) Blades bent in edge alignment shall not be repaired by anyone except the manufacturer.

(b) Possibility of repair of other bends will be determined by reference to the curves of figure 14-XII, used in conjunction with the following paragraphs. These specify the reparable limits and the number of times a blade may be straightened. The angle of bend is determined by using a special protractor in the manner shown by figure 14-XII.

(c) After every cold straightening operation has been completed, it will be necessary to locally etch the entire reworked portion of the blade. Each time a blade is annealed and re-heat-treated to accomplish a repair, it will be necessary to completely etch the blade.

(d) Blades bent to angles not exceeding those given by curve A, on fig. 14-XII may be straightened cold.

(e) Blades bent to angles more than those given by curve A, but not exceeding those given in curve B, may be straightened cold not more than three times without annealing and re-heat-treating. Blades bent as indicated in this paragraph may be straightened only by authorized agencies.

(f) Blades bent to angles more than those given by curve B, but not exceeding those given in curve C, may be straightened not more than three times, provided that blades so bent have been annealed prior to each straightening. Blades bent as indicated in this paragraph shall not be straightened a fourth time.

(g) If the blade has been anodized and the anodizing needs replacement, the blade may be suspended in the anodizing solution horizontally with the leading edge up. A double loop of 1/8-inch aluminum wire resting in the lower retaining groove may be used to support the shank, and another double loop approximately a foot from the tip may be used to support the remainder of the blade. The aluminum wires will act as conductors for the electric current.

(h) At the time damaged blades are repaired, the following data should be noted for future reference:

Manufacturer's number and design number.

Service hours to date of damage.

Condition of blade before repair - this should include the blade thickness and degree of bend at each station where bending occurred.

Report of work accomplished, including re-surfacing, straightening, annealing, re-heat-treatment, etc. - sufficient evidence would be given to indicate that these operations were satisfactorily performed.

Final assembly inspection report.

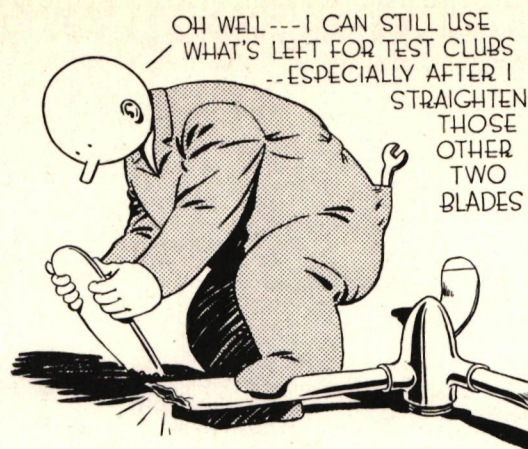
6. Trouble Locating.

Basically, there are two general types of trouble which might be encountered with the propeller; malfunctioning and failure to operate.

a. Malfunctioning.-

NOTE: Under malfunctioning, such conditions as a "rough" propeller, engine surging or "hunting," sluggish operation, and failure of the circuit breaker to stay closed are encountered.

(1) Rough Propeller.- A rough propeller is usually the result of a condition of the propeller blades and not the operating mechanism.



Examine the blades closely to see that they have not been badly scarred or damaged. Next, check the blades for "track" to make sure that they are not bent. If these checks fail to disclose the reason for roughness, the propeller must be checked for balance on a balancing stand.

To make a further check, take a smooth operating propeller off another plane and test it on the airplane where roughness is being experienced. If the substituted propeller is "rough," it is almost certain that the trouble does not lie with the propeller.

(2) Engine Surging or "Hunting". - Should engine surging occur when the propeller is operating in "AUTOMATIC," it may be caused by either faulty engine operation or faulty propeller control operation. To determine which system is malfunctioning, operate the propeller in "FIXED PITCH." If the surging stops during this operation, check the propeller control system.

First, inspect the relay to see that it is properly adjusted. Then inspect the governor contact points to see that they are clean and free from oil. If these checks fail to disclose the difficulty, it may be advisable to replace the governor assembly.

(3) Sluggish Operation. - Sluggish operation exists when the propeller responds slowly to control changes.

To check this condition, first see that the brake operates properly and is adjusted correctly. Second, inspect the governor contact points to see that they are clean and free from oil. Then, without running the engine, operate the propeller manually in both directions. If it fails to operate, check the pitch changing mechanism. If the propeller operates normally, check the relay to see that it is properly adjusted. If none of these checks reveal the difficulty, it may be found desirable to replace the governor.

(4) Circuit Breaker Fails to Stay Closed. - Failure of the circuit breaker to stay closed is caused by an overload condition.

Inspect the brake to see that it is operating properly and is adjusted correctly. Then inspect all wire connections for the possible existence of a short circuit.

Check the circuit breaker to see that it has the correct amperage for the installation. This 24-volt propeller should have a 25-ampere circuit breaker. If the circuit breaker does not have the specified rating, or is defective, it should be replaced.

b. Failure of the Propeller to Operate. -

NOTE: To locate the cause of the trouble, follow a step-by-step procedure until the cause is found through the process of elimination. First, check the battery to see that it is in good condition and fully charged. Then check the generator to make sure that it is supplying the battery with enough current to supply all electrical accessories which may be operating while the propeller is functioning. If the battery and generator are satisfactory, determine whether the propeller fails to operate manually and automatically, or whether it operates manually but NOT automatically.

(1) Fails to Operate Either Manually or Automatically. - If the propeller is inoperative in both positions, check the circuits to localize the cause.

First, remove the slip ring brush holder and place the circuit breaker in the "ON" position. Then, with the selector switch in the "DECREASE RPM" position, test the circuit with a test light or voltmeter connected to the No. 2 and No. 1 slip ring brushes, to see if current is getting through. The No. 2 slip ring is the common return, or negative connection, and the No. 1 slip ring is the "MANUAL DECREASE RPM" connection to the propeller circuit.

Then, with the selector switch in the "INCREASE RPM" position, test the circuit through the No. 2 and No. 3 slip ring brushes. The No. 3 slip ring is the "INCREASE RPM" connection to the propeller circuit.

If the test light, or voltmeter, shows there is current between the brushes of both circuits, the difficulty must lie forward of the slip rings in the propeller itself. To check the propeller, remove the motor cover and inspect the condition of the motor, the brush rigging,

the terminals and wire connections, and also the brake solenoids. If these inspections do not locate the difficulty, the propeller will have to be disassembled further.

If the test light, or voltmeter, indicates there is no current in either the "INCREASE RPM" or "DECREASE RPM" circuits, the difficulty must lie in the control system and it is probably possible to isolate the trouble by making one or more of the following checks.

Check the continuity of current through the circuit breaker. If continuity is lacking, replace the circuit breaker with one of the specified rating.

Check to see if there is continuity through the selector switch. If necessary, replace the selector switch.

Check to see that all wires are properly connected to the relay terminals and note that all connections are intact.

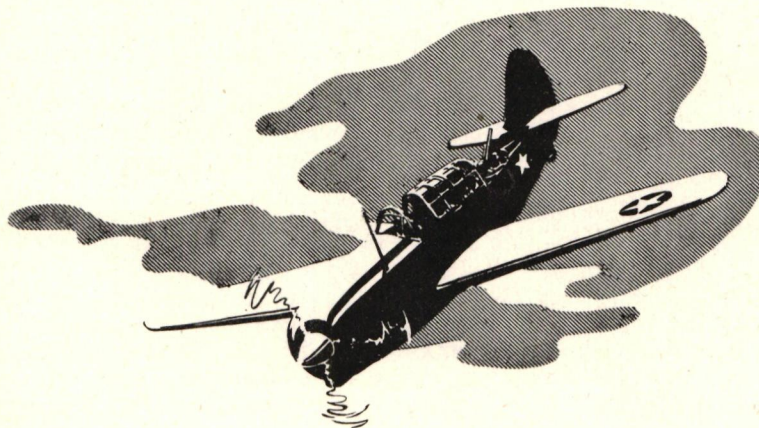
Inspect the solder connection of the electrical leads at the slip ring brush holder.

Make certain that the No. 6 relay terminal is grounded at the relay with the metal jumper that is provided to go between the No. 6 terminal and the relay box. One of these checks should reveal the difficulty.

(2) Propeller Operates Manually But Not Automatically.- If the propeller operates manually but not automatically, the difficulty lies in the governor or the relay, and the following checks should be made.

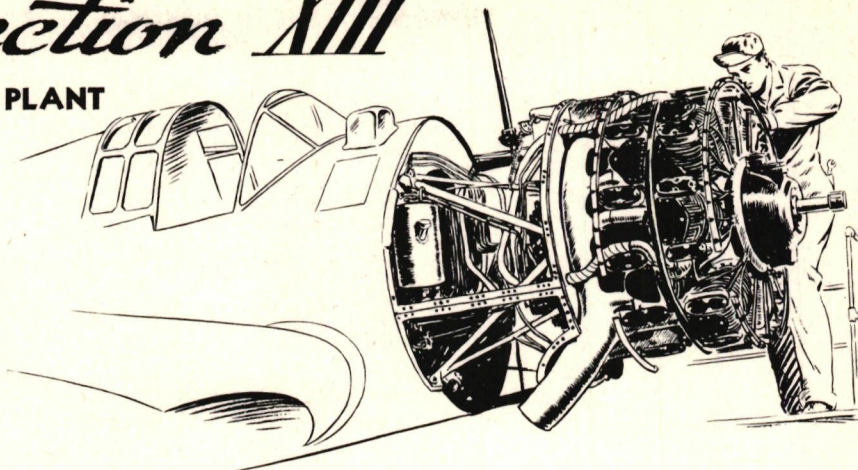
To check the governor, disconnect the electrical connector plug from the governor, and bridge with a thin wire (such as safety wire) from the "U" socket in the plug to the "T" socket, and then from "U" to "R." While performing these tests, have the selector switch in "AUTOMATIC." If the propeller operates while making this test, the trouble is in the governor.

If the propeller is still inoperative, it is desirable to inspect the wire connections at the relay. If the wire connections are satisfactory, it may be desirable to replace the relay with one which is operating properly.



Section XIII

POWER PLANT



1. Power Plant.

a. Engine.- The A-25A Airplane is powered with a Wright "Cyclone," model R-2600-8, 14 cylinder, two-row, geared, radial air-cooled engine. A two-speed supercharger is built integrally into the engine. The supercharger speed ratios are 7.06:1 and 10.06:1. The propeller reduction gear ratio is 16:9.

The rating of the engine, using 100 octane fuel conforming to Specification No. AN-F-28 and oil of grade 1120 conforming to Specification No. AN-VV-O-446, is as follows:

	BHP	RPM	MP	ALT.FT	BLOWER
Take-Off (5 min)	1700	2800	44.3	S.L.	"LOW"
Military Power (5 min)	1700	2600	41.5	5500	"LOW"
Military Power (5 min)	1450	2600	44.3	13500	"HIGH"
Normal Rated Power	1500	2400	37.5	6700	"LOW"
Normal Rated Power	1350	2400	41.0	13000	"HIGH"
Max. Overspeed Diving rpm		3100			
Spark Timing on No. 1 Cylinder					
Left Magneto (Rear Plugs)			20° BTC		
Right Magneto (Front Plugs)			20° BTC		
Spark Plug Cap			.012 inch		
Valves					
Intake Opens			20° BTC		
Intake Closes			50° ABC		
Exhaust Opens			65° BBC		
Exhaust Closes			40° ATC		
Valve Lift			.562 inch		
Valve Rocker Clearance, Cold			.010 inch		
Timing Clearance			.070 inch		
Running Clearance			.070 inch		
Oil Consumption					
At rated power, 1500 hp, at 2400 rpm, max.			20.1 quarts per hour		
At 75% rated power and 87.5% rated rpm.,					
1125 hp, at 2100 rpm, max.			8.9 quarts per hour		

The engine is attached to the engine mount ring by means of dynafocal suspension fittings Lord Assembly No. RL-25. Since these cushion-type fittings do not provide metal-to-metal contact between engine and mount, electrical bonding is installed.

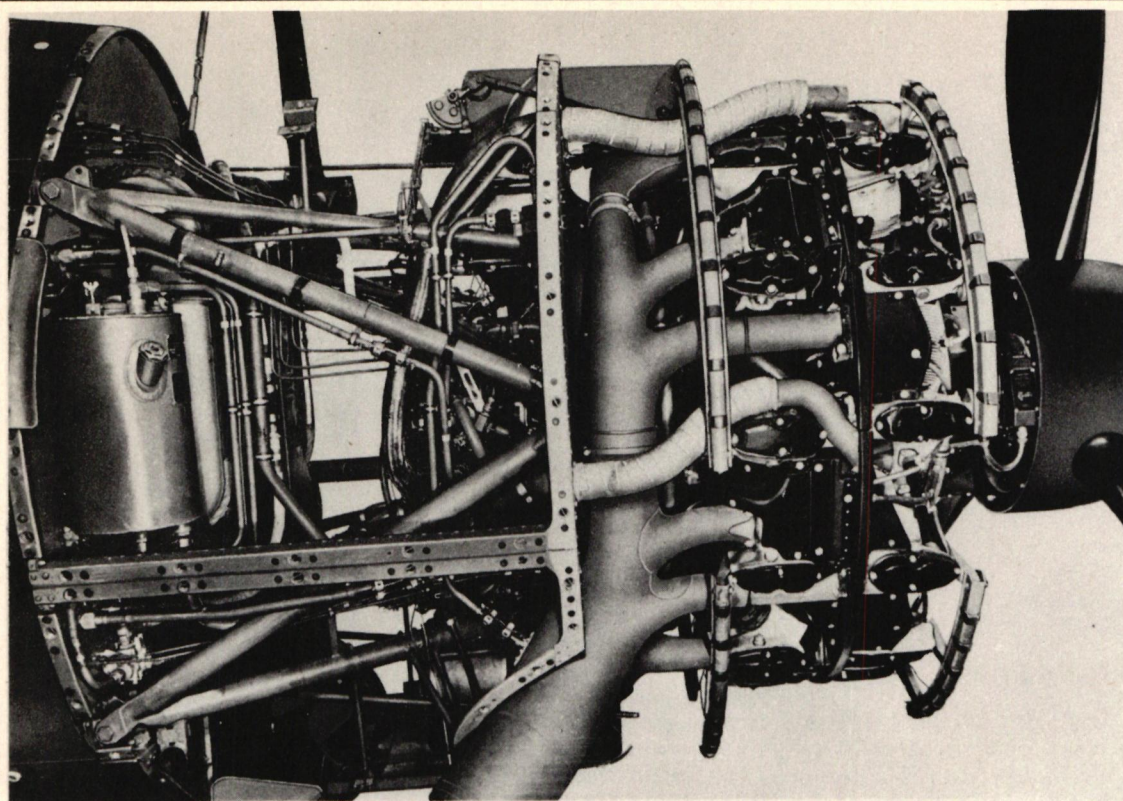


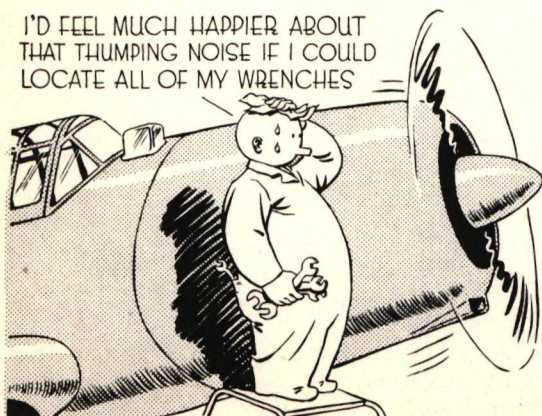
Figure 1-XIII - Power Plant Installation Right Side View

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b. Accessories.- The following accessories are installed on the engine:

Carburetor: Holley, Model 1685-HA.
 Magnetos (2): Bendix-Scintilla, Type SF14LN-3.
 Starter: Jack & Heintz, Type JH-5F.
 Generator: Auto-Lite 2CM70B5.
 Fuel Pump: Navy Type H4E3, Army Type G-9, AN4101.
 Vacuum Pump: Pesco, Model 3P-207-JA.
 Hydraulic Pump: Pesco, Model 1P-249-L.
 Tachometer Generator: AN-9533, Fig. 2.

Detailed information is given on the carburetor and magnetos in sections XV and XIV respectively. Information on the other accessories is given in the sections on the various systems to which they are related.



c. Removal and Installation of Power Plant.- The following procedure covers removal of the complete power plant, i.e., all items normally attached to and supported by the engine mount.

CAUTION: Before removal of any accessory, provision will be made to cover the opening to the interior of engine which such removal will expose. Cover can be made of sheet metal, fibre, wood, or hard cardboard. Leave the gasket on the pad and tighten cover enough to prevent the entrance of moisture and foreign matter. Be sure that hands are empty and that no loose wrenches or parts

are near opening when the accessory is lifted off pad. If foreign matter is allowed to enter engine or accessory housing, it will be necessary to dismantle the affected part, remove the foreign matter, and thoroughly clean the affected part at once. Crew Chiefs will be wise to account for every piece of lock wire, no matter how small, and every key, pin, nut, washer, etc., before reassembly of accessories.

Cut lock wire close to nut or screw head. Always cut on side of head opposite "pigtail" twist. This will make possible the removal of wire in "one piece."

Carefully wipe or brush the area surrounding the accessory to be removed. A small amount of care at this time may save hours of unnecessary labor.

An adequate supply of special and standard tools is furnished for the maintenance and repair of the airplane. Use them wisely.

Do not use wrenches which are too large. Turned corners and skinned knuckles will be your only reward. Keep screwdrivers, drift and center punches, etc., in proper condition. Do not use unauthorized extensions on any tool. Neither the part nor the tool were designed to stand such treatment. Proper care and use of tools is the mark of a good mechanic.

- (1) Remove all cowling as specified in part 2 of this section.
- (2) Remove the propeller and propeller brush assembly as specified in section XII of this Handbook.
- (3) Disconnect the radio antenna from the mast and remove the mast.
- (4) See that the fuel selector valve is "OFF," then drain fuel from the main strainer forward of the fire wall. Disconnect the pump supply line from the top of the fuel strainer.

NOTE: DISPOSITION OF DRAINED FUEL:

- (a) Except for the draining of sumps, strainers, etc., Air Forces Specification fuel removed from the tanks of the aircraft will be filtered into the regular storage system or field servicing truck for re-use in aircraft, unless such fuel is obviously unfit for further use in aircraft. Drums or other receptacles used for the draining of aircraft tanks will be free from water, dirt, sediment, etc., and, if necessary, will be thoroughly cleaned before being thus used.
- (b) When fuel, which is considered unsatisfactory for further aircraft use is drained from aircraft, it will be made available for use in Army Air Forces technical vehicles or for other authorized motive power use.
- (c) Fuel drained from aircraft will be properly accounted for, and the aircraft from which removed will be credited with the amounts drained therefrom.
- (5) Drain the oil from the engine and oil system as specified in section XVII of this Handbook. Disconnect the crankcase vent and radiator return lines from the top of the oil tank. Disconnect the pump supply line and radiator return line from the bottom of the oil tank.

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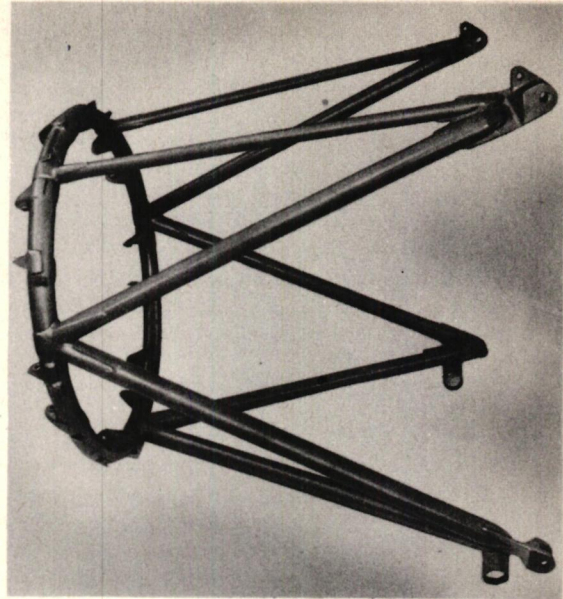


Figure 2-XIII - Engine Mount

(6) Disconnect the pump supply line at the bottom of the hydraulic reservoir and drain the fluid from the tank. Also, disconnect the pump pressure line from the hydraulic pressure regulating valve. A four-gallon container will be required, and it should be scrupulously clean if the fluid is to be re-used.

(7) Disconnect the fuel pump drain, hydraulic pump drain, and supercharger drain lines at the fire wall, below the hydraulic reservoir.

(8) Disconnect the fuel pressure, oil pressure, and manifold pressure gage lines at the fire wall, above the oil tank.

(9) Disconnect the vacuum line at the fire wall, above the hydraulic reservoir.

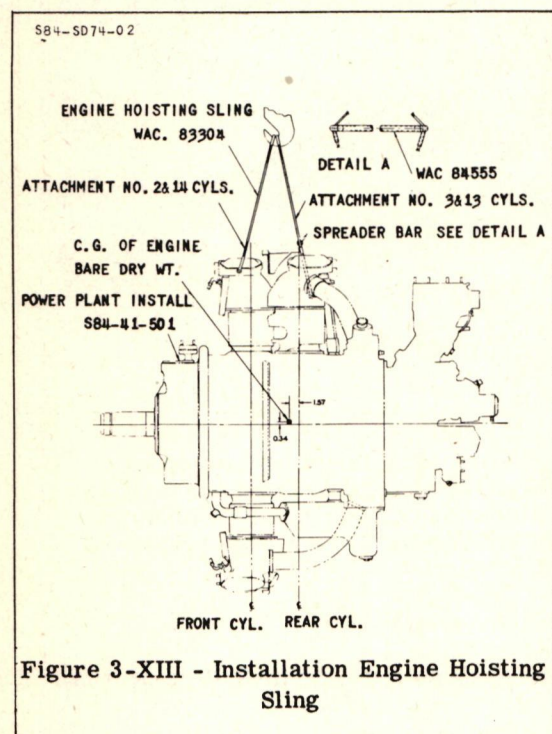


Figure 3-XIII - Installation Engine Hoisting Sling

(10) Disconnect the anti-icer line at the fire wall, below the main junction box.

(11) Disconnect the ventilator lines at the fire wall.

(12) Disconnect nine electrical conduits at the fire wall (two above the main junction box, six at the bottom, and one from the booster coil).

(13) Disconnect the cylinder head thermocouple leads at the fire wall terminal block, upper right-hand side.

(14) Disconnect the throttle, mixture, supercharger, propeller, and carburetor heat control rods at the quick-disconnect fittings above the main junction box.

(15) Disconnect the two cowl flap control rods at the quick-disconnect fittings (one above center and one at upper right hand corner of oil tank).

(16) Disconnect the two engine compartment cowl supports from the fire wall fittings by removing four cotter pins.

(17) Install the power plant hoisting equipment and attach to a hoist of at least two-ton capacity, following the specific procedure given in section XVIII of this Handbook.

(18) Raise and support the aft end of the fuselage to make the thrust line level or slightly nose down, employing procedure given in section VII of this Handbook.

(19) Remove the cotter pins, nuts, and washers from the two lower engine mount bolts at the fire wall, and take up on the hoist until the power plant load is removed from the lower fittings, freeing the bolts; then remove the bolts.

(20) See that all disconnected items are clear, and take up on the hoist to pull the lower portion of the engine mount forward and up a few inches from the fire wall fittings to free the two side cowl supports from the fire wall pins.

(21) Remove the two cotter pins, nuts, washers, and bolts from the top engine mount fittings at the fire wall. Restrain the engine mount as the bolts are removed to prevent it from swinging at random and causing damage.

(22) The power plant should be transferred to a stand with fittings located to match the fire wall fittings. The total weight of the detachable portion of the power plant is approximately 2626 pounds, and the center of gravity is located approximately 55.2 inches forward of the fire wall and .8 inch above the thrust line.

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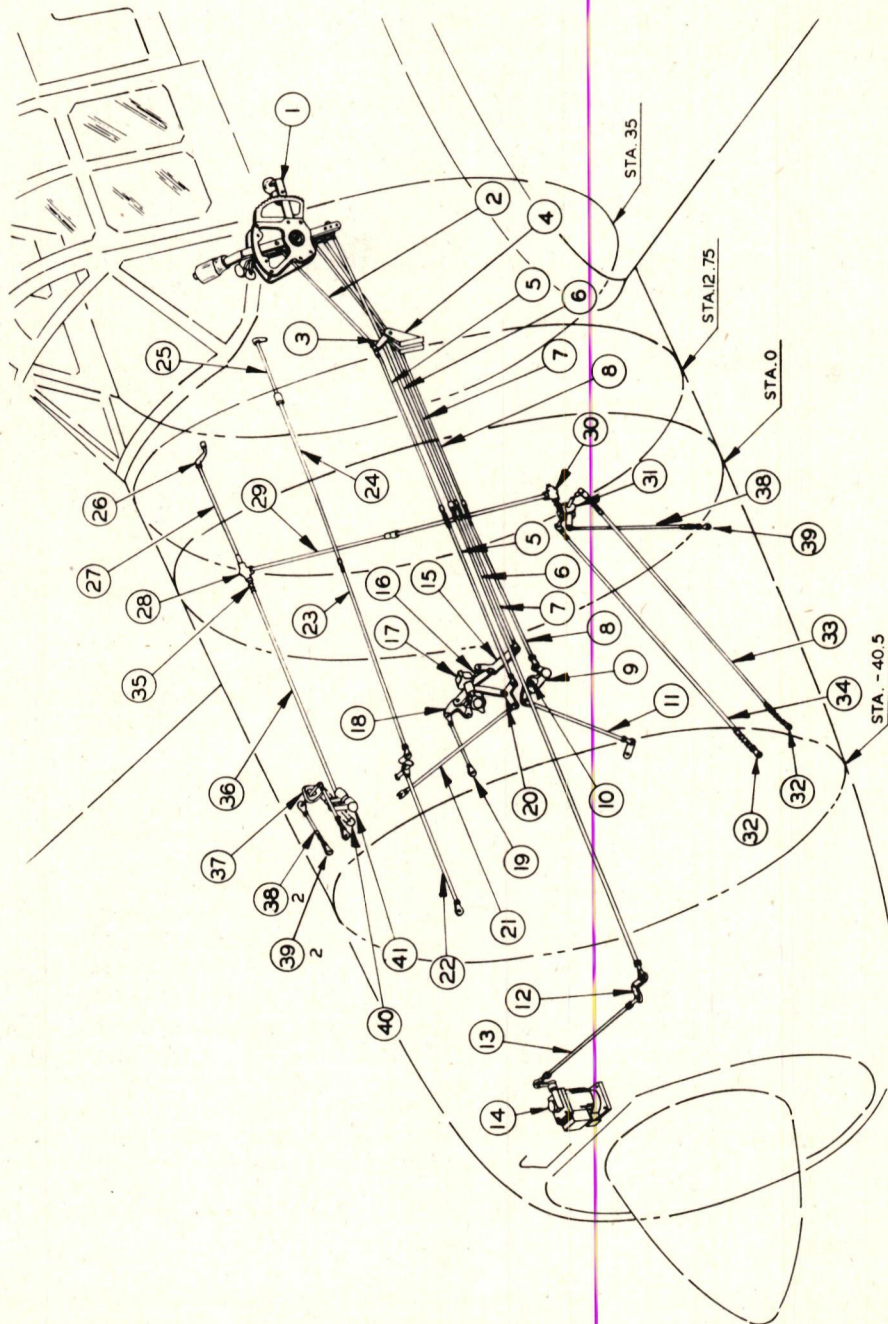


Figure 4-XIII - Engine and Propeller Controls

PARTS LIST - ENGINE AND PROPELLER CONTROLS

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Quadrant	S84-52-540
2	1	Tube Assembly	S84-52-532
3	1	Lever Assembly	S84-52-519
4	1	Support Assembly	S84-52-520
5	2	Throttle Rod Assembly	S84-52-523-1
6	2	Propeller Rod Assembly	S84-52-524-1
7	2	Mixture Rod Assembly	S84-52-525-1
8	2	Supercharger Rod Assembly	S84-52-526-6
9	1	Support Assembly	S84-52-533
10	1	Clamp	S84-52-536
11	1	Rod Assembly	1079-D-2-2B-11-62
12	1	Bell Crank	1057-D-90-1.75-2.50
13	1	Tube Assembly	1079-D-2-2B-12.75
14	1	Governor (Curtiss Prop. Div.)	No. 102400
15	1	Bell Crank	1020-D-120-2.5-5.75
16	1	Rod Assembly	1079-D-2B-3.62
17	1	Support	S84-52-522
18	1	Bell Crank	1020-D-120-2.5-5 3/16
19	1	Rod Assembly	S84-52-518
20	1	Bell Crank	1020-D-90-3.75-4.50
21	1	Rod Assembly	1079-D-2-2B-17.25
22	1	Rod Assembly	S84-51-556
23	1	Rod Assembly	S84-51-518-1
24	1	Rod Assembly	S84-51-518-2
25	1	Control Handle	S84-51-559
26	1	Handle Assembly	S84-28-592
27	1	Tube	S84-28-546
28	1	Housing Assembly	S84-28-552
29	1	Tube	S84-28-550
30	1	Tube and Housing Assembly	S84-28-568
31	1	Gear Assembly	S84-28-549
32	2	End Assembly	S84-28-582-1
33	1	Rod Assembly	S84-28-582-5
34	1	Rod Assembly	S84-28-582-2
35	1	End Assembly	S84-28-547-4
36	1	End Assembly	S84-28-547-1
37	1	Scoop Assembly	S84-51-511
38	3	Rod Assembly	S84-28-545-2
39	3	Rod Assembly	S84-28-545-1
40	1	Strut Assembly	S84-28-521
41	1	Support Assembly	S84-52-522

NOTE: To remove the engine only, from the mount, employ the engine hoisting sling as directed in section VII of this Handbook. Do not hoist the entire power plant with the engine hoisting sling alone.

To install the power plant, reverse the foregoing procedure. Following the installation, the hydraulic and oil tanks must be serviced, and the engine must be pre-oiled before it is operated.

2. Power Plant Controls.

a. Power Plant Control Quadrant.- The power plant control is located on the left side of the pilot. This quadrant comprises levers which operate the throttle, mixture, supercharger blower ratio, and propeller governor controls. The control linkage is a simple arrangement of push-pull tubes and bell cranks, running along the left side of the fuselage, and engine accessory compartment. The control rods are provided with disconnect fittings immediately ahead of the fire wall to facilitate removal and installation of the power plant.

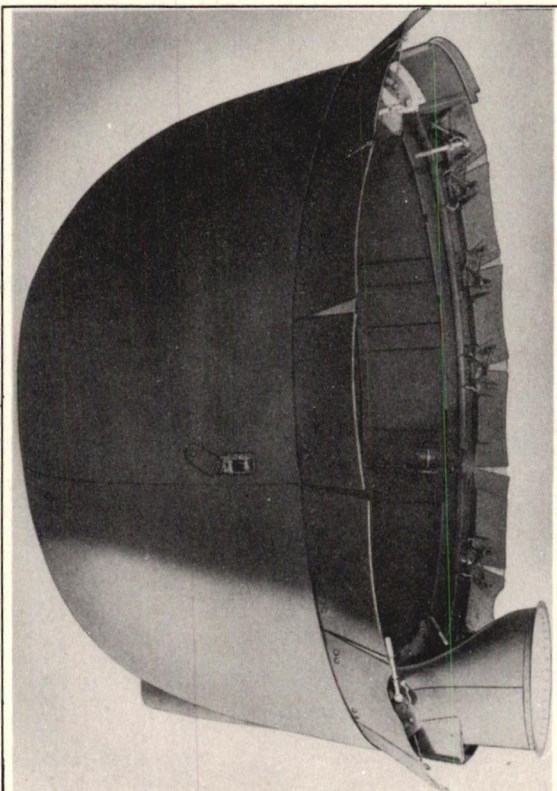
The operation of the power plant controls should be evident from fig. 4-XII. Due to the

nature of the parts used in this installation, damaged parts should be replaced, although slightly bent push-pull tubes may be straightened.

b. Cowl Flaps. - Cowl flaps are provided for controlling air flow through cowling. Flaps are located just forward of the shroud completely around the cowl, and two additional flaps are provided at the bottom of the cowling just forward of the fire wall in the oil cooler air stream. All cowl flaps are operated simultaneously by a control handle on the right side of the pilot's cockpit.

The cowl flap actuating mechanism is shown on fig. 6-XIII. Clockwise turning opens the flaps and counterclockwise turning closes them. The cowl flap control action is purely mechanical through torque tubes, gears, and sprocket drives. Due to the simplicity of this arrangement, the operation should be evident.

Because of the nature of the parts used in this installation, damaged parts should be replaced, although slightly bent torque tubes may be straightened.



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Figure 5-XIII - Detachable Engine Cowling

c. Carburetor Air Heat. - The temperature of the incoming air to the carburetor is controlled by a door in the forward part of air scoop. The position of this door in the air scoop is controlled by the knob on the left side of the instrument panel through a push-pull tube assembly as shown on fig. 6-XIII. When the knob is in the "DIRECT" (cold) position, the door is down, flush with the bottom of the air scoop permitting air to flow into the carburetor from the passage in the top of the cowl. When the knob is pulled outward the "ALTERNATE" (hot) position, the door is raised up, cutting off air from the passage in the top of the cowl and drawing in heated air from around the cylinders, from the opening in the bottom of the air scoop.

A backfire door is provided in the air scoop to relieve pressure in case of a backfire. Any damaged parts of the carburetor heater system should be replaced except slightly bent tubes that can be straightened.

3. Initial Operation and Ground Test for Engines Stored According to Specification No. AN-F-E-568.

NOTE: This procedure is only for engines removed from storage according to Specification No. AN-F-E-568 using pliofilm envelopes, de-

hydrator plugs, and bags of dehydrating agent distributed around the engine.

HUMIDITY INDICATION CHART

SAFE		UNSAFE	
Dark Blue Color	Lavender Color	Bluish Pink Color	Pink Color

SILICA-GEL

Dark Blue Color	Lavender Color	Bluish Pink Color	Pink Color
Activated	20% Rel. Hum.	40% Rel. Hum.	60% Rel. Hum.

a. General Instructions. - The initial starting and ground operation of Wright "Cyclone" R-2600-8 engines after removal from storage conforming to Specification No. AN-F-E-568 as defined above will conform to the following instructions:

b. Oiling of No. 5, 7, and 9 Exhaust Rocker Boxes. - Place from one-half to one pint of oil, grade 1120, Specification No. AN-VV-0-446, in Nos. 5, 7, and 9 rocker boxes before engine run up. Due to the inverted position of the cylinders, it is desired that the oil be frozen with dry ice or other means, then packed into the rocker box. However, if facilities for freezing the oil are not available, it is satisfactory to remove the lower nose cowl stud on the rear exhaust rocker box for filling with oil. After filling, replace the stud, using thread compound. Make certain that the projecting height of the stud is the same as before removing so that no interference is encountered with the rocker arm by tightening this stud an excessive amount. After inserting stud, make certain that it is safetied to the upper stud. Any action taken should be noted on form 60B. It is satisfactory to perform this operation any time on engine assembly line after the engine is placed in the vertical position.

c. Filling Carburetor. - At least 24 hours prior to operation of the engine, fill the carburetor diaphragm chamber to normal level through the fuel inlet port with 100 octane gasoline conforming to Specification No. AN-F-28. This may be accomplished by any means that will supply clean fuel to the fuel inlet under approximately six pounds per square inch pressure. The diaphragm mechanism will automatically cut off the fuel flow into the carburetor when the proper level is reached. After disconnecting the fuel supply, check to see that the check valve in the carburetor inlet is not leaking.

d. Pre-Starting Inspection. - Perform the following checks prior to the initial start of the engine:

(1) BE SURE THAT THE IGNITION AND STARTER SWITCHES ARE "OFF" BEFORE MOVING PROPELLER.

(2) Remove Cowling. - Disconnect the cowl flap controls and remove all of the engine and accessory compartment cowling.

(3) Ignition. - Check the ignition grounding circuit for proper connection to the magnetos and ignition switch.

(4) Generator and Starter. - Check the generator and starter for security of mounting and proper connection of electrical conduit. Remove all masking tape.

(5) Engine Vents and Intakes. - Remove all masking tape and temporary closures from all engine vents and intakes.

(6) Air Scoops. - Check the air scoop and carburetor air duct for presence of foreign objects. (Remove silica-gel bags.)

(7) Exhaust Manifold. - Check the exhaust manifold for proper installation and safety. (Remove silica-gel bags.)

(8) Engine Baffles. - Inspect the engine baffles for proper installation and safety.

(9) Cooling Tubes. - Check the magneto, generator, and fuel pump blast tubes for proper installation and safety.

(10) Propeller and Spinner. - Check the propeller and propeller spinner for proper installation according to section XII. Do not make any type of propeller operation check. A propeller governor will not be installed on an engine for the ground-test. The governor mounting pad will be covered with a plate which will prevent the escape of oil through the governor mounting pad oil passage. The foregoing procedure is necessary to prevent the entrance of rust-preventive compound into the governor. This compound has been found to remain in the governor and cause malfunction. It will be noted by operating personnel that the engine is not being governed by propeller control in this condition, necessitating that any changes in speed be accomplished by changes in throttle setting or manually from the propeller switch box. Since the airplane is at

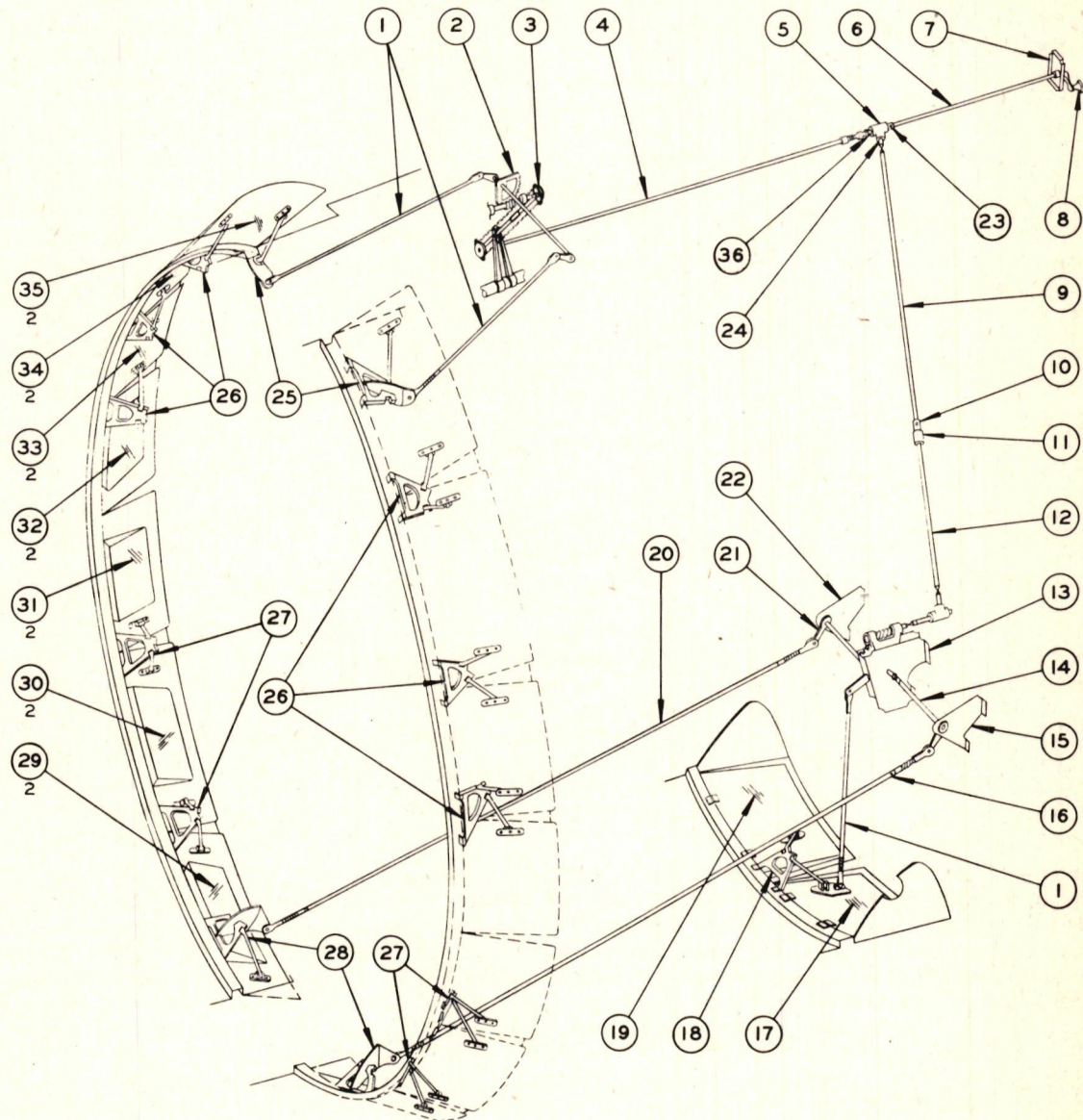


Figure 6-XIII - Engine Cowl Flaps and Controls

PARTS LIST - ENGINE COWL FLAPS AND CONTROLS

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	3	Rod Assembly	S84-28-545-2
2	1	Scoop Assembly	S84-51-511
3	1	Strut Assembly	S84-28-521
4	1	Tube Assembly	S84-28-547
5	1	Housing Gear Assembly	S84-28-552
6	1	Rear Tube	S84-28-546
7	1	Support	S84-28-526
8	1	Handle Assembly	S84-28-592
9	1	Front Tube	S84-28-550
10	1	Connector Sleeve	S84-28-553
11	1	Sleeve	S84-28-561
12	1	Tube and Housing Assembly	S84-28-568
13	1	Gear Assembly	S84-28-549
14	1	Shaft Assembly Left	S84-28-584
15	1	Support Assembly Left	S84-28-574
16	1	Rod Assembly	S84-28-582-5
17	1	Flap Assembly Left	S84-29-515-6
18	1	A Frame Assembly	S84-29-514-20
19	1	Flap Assembly Right	S84-29-515-7
20	1	Rod Assembly	S84-28-582-2
21	1	Shaft Assembly Right	S84-28-588
22	1	Support Assembly Right	S84-28-589
23	1	Sleeve	S84-28-559
24	1	Reducer	S84-28-503-10
25	2	Lever Assembly	S84-28-502-10
26	6	Lever Assembly	S84-28-502-9
27	4	Lever Assembly	S84-28-504-5
28	2	Lever Assembly	S84-28-504-4
29	1L & 1R	Flap Assembly	S84-28-504-1
30	1L & 1R	Flap Assembly	S84-28-504-2
31	1L & 1R	Flap Assembly	S84-28-504-3
32	1L & 1R	Flap Assembly	S84-28-502-5
33	1L & 1R	Flap Assembly	S84-28-502-6
34	1L & 1R	Flap Assembly	S84-28-502-7
35	1L & 1R	Flap Assembly	S84-28-502-8
36	1	Bearing Assembly	S84-28-537

rest, the engine will not overspeed unless testing is conducted at high altitudes. Operating personnel will exercise care in opening the throttle widely, with a view to preventing engines from over-speeding. After the engine or engines have been ground-tested, the lubricating oil will be drained from the oil system. The oil system will then be filled with new oil and part f again complied with. This drained oil is not suitable for further use in aircraft engines since the corrosion-preventive compound in the oil promotes rapid sludging with consequent sticking of piston rings. The drained lubricating oil will not be placed in containers for reclaiming.

(11) Oil Tank, Cooler, and Hydraulic Reservoir. - Check the installation of the oil tank, oil cooler and temperature regulator, and hydraulic reservoir for proper installation and safety.

(12) Engine Installation. - Check all bolts and nuts of the engine installation to see that they are tight and properly safetied.

(13) Electrical Connections. - Check the oil dilution, primer, oil temperature, head temperature, tachometer, and propeller conduit for security of installation.

(14) Mechanical Starter Clutch Control. - Check the mechanical starter clutch control to make sure that the clutch is in the full disengaged position.

(15) Landing Gear. - Check to see that the landing gear is locked "DOWN." The first check should be made by noting the position of the flag farthest inboard from each forward wing fold

hinge. When each half of the landing gear is locked "DOWN" the corresponding flag will extend above the top surface of the wing. A second check to be made, electrically (check 19), will also indicate the position of the landing gear mechanism.

(16) Batteries. - Check the batteries if there is any reason to believe that they are not well charged. Do not start or operate the engine unless the specific gravity of the electrolyte in each battery is above 1.250.

(17) Engine and Propeller Controls. - Check the engine and propeller controls from the quadrant to the engine for security of installation, and full and free movement.

(18) Carburetor Air Heat Control. - Check the carburetor air heat control for proper installation and operation. Leave the control in the "DIRECT" position after this check.

(19) Circuit Breakers and Switches. - LEAVE THE STARTER AND IGNITION SWITCHES "OFF."

Place the battery switch in the "BATTERY" position.

Place the generator switch in the "GENERATOR" position.

Place the primer and oil dilution circuit breaker in the "UP" position (B).

Place the fuel gage and howler breaker-switch in the "UP" position (B).

Place the starter circuit breaker in the "ON" position.

Place the propeller switch in the "OFF" position; then place the propeller circuit breaker in the "ON" position.

If a circuit breaker or breaker-switch kicks "OFF," an overload or short circuit is indicated, and the engine should not be started until the cause of the trouble has been found and corrected. When the circuit breaker marked "FUEL GAGES AND HOWLER" is "ON," the throttle less than 1/4 open, the howler will sound if the tail wheel or either half of the landing gear is not in the locked "DOWN" position.

(20) Vacuum Pump Lubrication. - To check rate of lubrication of the vacuum pump, disconnect the line from the vacuum pump to the oil separator and install a vented container to receive the vacuum pump discharge. The oil discharge (to be checked during engine warm-up) should not be less than three cc in fifteen minutes at 1000 rpm.

(21) Magnetos. - Examine the cam follower felt to see that it is properly lubricated. If oil appears on its surface when the felt is squeezed with the fingers, do not add oil. However, if it is dry, moisten it with oil, grade 1100 or 1120 Specification No. AN-VV-0-446. Do not apply too much oil as the excess will be thrown off during operation and will come between the contact points thereby causing pitting and burning.

e. Filling Tanks. -

(1) Fill oil tank with 15 to 25 U. S. gallons (12.8 to 20.8 Imperial gallons) of oil conforming to Specification No. AN-VV-0-446, grade 1100 or 1120, as required. Replace the cap.

(2) Fill the fuel tanks with 100-octane fuel conforming to Specification No. AN-F-28. The approximate capacity of each tank is as follows:

Left wing tank - - - - -	100 U. S. gallons (83 Imperial gallons)
Right wing tank - - - - -	100 U. S. gallons (83 Imperial gallons)
Fuselage tank (metal) - - - - -	90 U. S. gallons (74.9 Imperial gallons)

NOTE: See section XVI for handling fuel and filling tanks.

(3) Check the hydraulic fluid level in the hydraulic reservoir. Add hydraulic fluid conforming to Specification No. AN-VV-0-366a if required.

f. Pre-Oiling.-

- (1) Remove the dehydrator plugs from all spark plug openings.
- (2) Carefully loosen the oil inlet connection at the oil pump and drain approximately one gallon of oil from the line. The purpose of this procedure is to remove all air from the line.
- (3) Reconnect the line to the oil pump.
- (4) Remove the 1/4-inch pipe plug from the left side of the oil pump body.
- (5) See that the ignition and starter switches are "OFF" and the mixture control is in "FUEL CUT-OFF" position; then pull the propeller through by hand until sufficient oil is expelled through the hole (from which the plug was removed) to indicate that no air remains in the oil pump.
- (6) Using flexible tubing and appropriate fittings, connect a pre-oiling pump (with oil heating provisions) to the tapped hole from which the 1/4-inch pipe plug was removed.
- (7) While pulling the propeller through by hand, pump into the engine approximately 1-1/2 gallons of hot oil 38 degrees C to 54 degrees C (100 degrees F to 130 degrees F), of the same grade, brand, and specification as that in the oil tank.
- (8) Disconnect the pre-oiling pump and re-install the 1/4-inch pipe plug. Safety the plug with lock wire after tightening.
- (9) Check the entire oil system for leaks.
- (10) Check the quantity of oil in the oil tank. Add oil of same grade, brand, and specification if necessary to bring level to 12 to 25 U. S. gallons (10 to 20.8 Imperial gallons).

g. Installing Spark Plugs.-

- (1) After pre-oiling the engine, pull the propeller through five revolutions, or more if required, to expell any excess oil that may have collected in the intake pipes and cylinders.
- (2) When cylinders are clear, install all spark plugs. Make sure that a washer is under each spark plug, except the plug under which the thermocouple is installed, and tighten plugs, applying 450 to 500 inch-pounds torque.
- (3) Clean the contact sleeve of the spark plug elbows with a cloth saturated with carbon tetrachloride, and do not touch them with the fingers after cleaning. Attach the spark plug elbows to the spark plugs.
- (4) Check to see that all baffles are properly installed after securing spark plugs and ignition wires.

h. Fuel System.-

- (1) With the fuel selector valve turned to a tank, operate the electric emergency fuel pump controlled from the main switch box, and check the fuel system for leaks. Do not operate the booster pump located on the fuselage tank except to check its operation.
- (2) Check the fuel pressure maintained by the emergency pump. If pressure is not $7-1/2 \pm 1/2$ pounds per square inch, adjust the pump relief valve to obtain this pressure.
- (3) Disconnect the main primer line from the distributor fitting below the left side of the carburetor. With the emergency fuel pump operating, turn the primer switch to "PRIMING PUMP" momentarily to check primer operation. Receive discharged fuel in a container. Check to see that primer shuts off properly, then reconnect the primer line to the distributor fitting.
- (4) Disconnect the oil dilution line between the solenoid and the lower shut-off valve. Be certain the lower shut-off valve is "OFF." With the emergency fuel pump operating, turn the

oil dilution switch to "OIL DILUTION" and receive the discharged fuel in a suitable container. Check the rate of discharge for constant flow, then turn the oil dilution switch "OFF" and check to see that solenoid valve shuts off flow completely. Turn the emergency fuel pump switch "OFF" and reconnect the oil dilution line. Close the shut-off valve unless oil dilution is to be employed.

(5) With emergency fuel pump "OFF," remove the drain plug from the bottom of the diaphragm housing of the carburetor, and drain all of the fuel present into a container. Inspect for contamination other than flushing oil. Operate emergency fuel pump momentarily for additional flushing if drained fuel contains sediment. Replace the drain plug, tighten and safety after draining or flushing.

(6) Remove and clean the screen of the carburetor strainer. To remove the screen, unscrew the large plug below the fuel inlet port. After cleaning, replace all parts in correct order and safety.

(7) Turn the fuel selector valve "OFF," drain the main fuel strainer, then remove and clean the screen. Provide a container to receive the fuel that will drain from the lines. After cleaning, re-install the screen and safety the thumbscrew and drain cock.

i. Preparation for Starting. - Immediately before starting the engine, perform the following:

(1) Remove the magnetic drain plug from the bottom of the engine scavenger sump to drain any excess oil that has accumulated from the pre-oiling operation. Replace and safety the plug.

(2) Head the airplane into the wind.

(3) Check to see that all engine and accessory compartment cowling has been removed.

(4) Block both wheels of the airplane with wheel chocks.

(5) Check the hydraulic accumulator pressure. If the pressure is low, build it up to 1000 pounds per square inch minimum with the hand pump. Maintain this pressure while starting the engine to prevent air from entering the accumulator.

(6) Pull the propeller through three or more complete revolutions in the normal direction of engine rotation by hand, with the throttle wide open to clear the lower cylinders of any fuel or oil that may have accumulated. If there is any reason to believe that the lower cylinders are filled with fluid, or if unusual resistance to turning is encountered, remove the spark plugs from the lower cylinders before continuing the pull-through of the propeller. Replace spark plugs and ignition wires after clearing cylinders.

(7) Connect a 24-volt car battery of at least 34 ampere-hours capacity to the external power connector.

(8) Check to ascertain that the propeller is in low pitch. If it is not in low pitch, turn the propeller circuit breaker "ON" and place the propeller switch in "INCREASE RPM" until the low limit switch cuts out operation of the propeller. Return the propeller switch to the "AUTOMATIC" position.

(9) Fire Extinguisher. - Have fire extinguishers available for immediate use.

(10) Propeller Clear. - Be certain that all objects are clear of the propeller.

(11) With the propeller circuit breaker "ON," place the propeller switch in "INCREASE RPM" until the low limit stop cuts out operation of the propeller.

j. Starting. -

NOTE: During the ground run, check the fuel gages at frequent intervals. Never permit the engine to operate on a fuel tank until it becomes dry. It is recommended that the engine be started with the fuel selector valve in a full tank position. However, any fuel tank may be selected during the ground run as long as it contains sufficient fuel to run the engine without running dry.

The cowl flaps must be open. Closing the cowl flaps may result in cylinder fins cracking because of temperature differentials and burning of ignition system insulation.

The engine should never be operated with less than 12 U. S. gallons (10 Imperial gallons) of oil in the tank.

(1) Position of Controls. - See that the following controls are in the positions noted:

Ignition switch	- - - - -	"OFF"
Starter switch	- - - - -	"OFF"
Battery switch	- - - - -	"BATTERY"
Generator switch	- - - - -	"GENERATOR"
Carburetor heat control	- - - - -	"DIRECT"
Supercharger control	- - - - -	"LOW"
Throttle control	- - - - -	set for 700 rpm to 800 rpm
Mixture control	- - - - -	"FUEL CUT-OFF"
Propeller switch	- - - - -	"OFF"
Propeller circuit breaker	- - - - -	"ON"
Propeller control (on quadrant)	- - - - -	full "INCREASE RPM"
Fuel selector valve	- - - - -	to a full tank
Emergency fuel pump switch	- - - - -	"EMERGENCY FUEL PUMP"

NOTE: The mixture control for the Holley carburetor has three definite positions: full "RICH," "CRUISING LEAN," and "FUEL CUT-OFF." The mixture control must be in the "FUEL CUT-OFF" position whenever the engine is not running.

To guard against fires, scoring of cylinder walls, or flooding of the lower cylinders, never start the engine with the mixture control in full "RICH," and never prime until the engine is turning over.

(2) Energize Starter. - Place the starter switch in the "START" position and hold for 15 to 20 seconds to energize the inertia element at temperatures above 0 degrees C (32 degrees F). Energize 30 seconds for temperatures below 0 degrees C (32 degrees F).

(3) Ignition on "BOTH". - Place the ignition switch in the "BOTH ON" position.

(4) Engage Starter. - Move the starter switch from the "START" to the "MESH" position.

NOTE: If the engine does not start after 30 seconds of operation, allow the starter motor to cool at least two minutes.

(5) Prime (if required). - As soon as the starter is engaged and the engine is turning over, place the primer switch in the "PRIMING PUMP" position for a maximum of five seconds if priming is required. Use only sufficient priming to start the engine, giving due consideration to atmospheric and engine temperatures.

NOTE: If the engine becomes over-primed, see that the ignition and starter switches are "OFF," open the throttle wide and turn the engine over by hand until it is cleared out. When clear, return the throttle to the starting position to give 1000 rpm. Do not attempt to prime the engine by pumping the throttle. The accelerating pump is not mechanically connected to the throttle and, therefore, cannot be operated in this manner.

(6) Mixture full "RICH," Starter "OFF". - When the engine fires, move the mixture control immediately to the full "RICH" position, and place the starter in the "OFF" position.

(7) Caution. - Watch oil pressure. If the oil pressure gage does not indicate pressure within 30 seconds after starting, stop the engine immediately by moving the mixture control to the "FUEL CUT-OFF" position. Turn the ignition switch "OFF" after the engine stops. Do not restart the engine until the cause of the oil pressure failure has been determined and remedied.

(8) Prime as Required. - Prime sparingly as required to obtain smooth operation.

(9) Disconnect Cart Battery. - After the engine has been started, disconnect the cart battery.

(10) Failure of Engine to Start. - If the engine fails to start upon the first attempt, turn the ignition and starter switches "OFF" and repeat the starting procedure. Do not, however, over-prime the engine. If the engine fails to start after a reasonable number of attempts, place the mixture control in the "FUEL CUT-OFF" position, turn the ignition, starter, and other switches "OFF" and check the ignition, fuel, and general power plant installations to determine the trouble.

CAUTION: In case disengagement of the starter and engine jaws did not occur due to engine compression, turn the propeller by hand (ignition "OFF") one-half revolution in either direction of rotation to release the starter jaw.

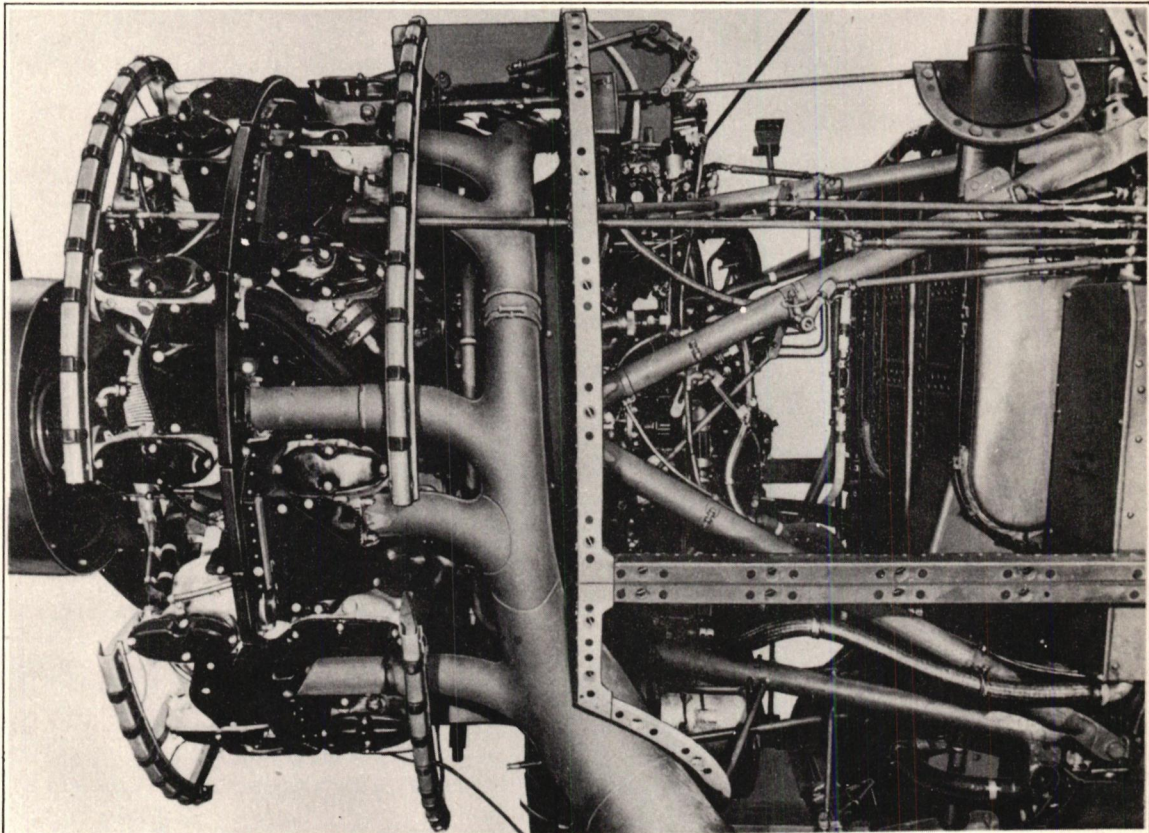


Figure 7-XIII - Power Plant Installation, Left Side View

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k. Warm-up and Preliminary Ground Run. -

- (1) Be sure the mixture control is in the full "RICH" position.
- (2) Turn emergency fuel pump "OFF."
- (3) During warm-up and ground operation, the following limits for the items noted will apply:

Oil temperature (after warm-up)	55° - 85° C (131° - 185° F)
Oil pressure (except idle)	75 - 90 pounds per square inch
Oil pressure (idle)	25 pounds per square inch minimum
Cylinder head temperature (below 2000 rpm)	205° C (400° F) maximum
Fuel pressure	6 - 7 pounds per square inch
Hydraulic system pressure	1000 pounds per square inch

- (4) Operate the engine at 1000 rpm for five minutes.

(5) Check the oil temperature and pressure.

(6) Check the cylinder head temperature. Do not allow it to exceed 205 degrees C (400 degrees F).

(7) Check the operation of the fuel selector valve by switching successively to all fuel tanks containing fuel.

(8) Throttle the engine and make the following idling adjustment:

(a) With the mixture control in the full "RICH" position, adjust the throttle stop so the engine idles at 400 rpm.

(b) Adjust the idle mixture control to give maximum speed at this throttle setting.

(c) Readjust the throttle stop to idle the engine at 400 rpm.

(d) Readjust the idle mixture to give maximum speed at throttle setting (c) above.

(e) Reset the throttle stop to give an idling speed of 600 rpm.

NOTE: Avoid running the engine more than necessary below 1000 rpm. Prolonged idling will result in fouled spark plugs.

(9) Open the throttle to 1200 rpm and run at this speed for 10 minutes if this can be done without exceeding a cylinder head temperature of 205 degrees C (400 degrees F).

(10) Check the manual operation of the propeller at 1200 rpm. With the propeller circuit breaker "ON," place the propeller switch in "DECREASE RPM" until a loss of 200 rpm is noted. Place the propeller switch in "INCREASE RPM" until the engine regains its lost rpm. With the propeller control on the quadrant in full "INCREASE RPM" return the propeller switch to "AUTOMATIC."

(11) During operation at 1200 rpm, check and record the oil temperature, fuel pressure, and vacuum.

NOTE: Vacuum system limits are 4.00 to 5.00 inches of mercury. Desired value is 4.25 inches of mercury.

(12) Without stopping, open the throttle to 1440 rpm and run at this speed for 10 minutes if this can be done without exceeding a cylinder head temperature of 205 degrees C (400 degrees F).

(13) During the run-up from 1000 to 1440 rpm, check and record the speed at which the generator cuts in. After generator cuts in, check and record the voltage and current readings.

(14) During operation at 1440 rpm, check and record the oil temperature and pressure, cylinder head temperature, fuel pressure, and vacuum. Check the fuel quantity gages.

(15) Check the hydraulic accumulator pressure. It should be 1000 to 1050 pounds per square inch.

(16) With the propeller switch in "OFF," propeller circuit breaker "ON," and propeller control in full "INCREASE RPM," open the throttle to 2000 rpm but do not exceed 30 inches of mercury. Perform the following:

(a) Check and record the oil temperature and pressure, cylinder head temperature, fuel pressure, and vacuum at 2000 rpm and not over 30 inches of mercury. Check fuel quantity gages.

NOTE: If the cylinder head temperature rises above 205 degrees C (400 degrees F) during the following checks, close the throttle to 1000 rpm and allow the engine to cool.

(b) Make certain that the propeller is in low pitch by placing the propeller switch in "INCREASE RPM." Then place the propeller switch in the "OFF" position. With the throttle at 2000 rpm (do not exceed 30 inches of mercury), check magnetos by switching momentarily from

"BOTH" to "LEFT" then back to "BOTH" then to "RIGHT" and back to "BOTH." (Allow the engine to regain its lost rpm after checking the right magneto by switching back to "BOTH.") Check and record the drop in rpm for each magneto. Normal drop is 75 to 100 rpm, but should not exceed 100 rpm. The check on each magneto should be as short as possible to avoid damage from detonation.

(17) Check the operation of the supercharger. With the engine speed at 1700 rpm, move the supercharger control lever to the "HIGH" position and lock. Open the throttle to obtain not over 30 inches of mercury manifold pressure or 2000 rpm. When the engine speed has stabilized, observe the manifold pressure and immediately shift the supercharger to "LOW" position without moving the throttle. A sudden decrease in manifold pressure is an indication that the two-speed supercharger drive is operating properly.

CAUTION: All shifts of the supercharger control should be made directly to the full "HIGH" or "LOW" position without hesitating between the stops.

NOTE: High clutch shifts should not be attempted at engine speeds below 1700 rpm and, while shifting is permissible at speeds above 1700 rpm, it is recommended that all shifts be effected at 1700 rpm.

(18) Close the throttle to 1000 rpm and allow the cylinders to cool.

(19) With the propeller control in full "INCREASE RPM" and the engine turning over approximately 700 rpm, turn the ignition switch "OFF" momentarily to note whether or not the engine stops firing and immediately return to the "BOTH" position. Two or three seconds is ample time for the switch to remain in the "OFF" position.

1. Stopping. - Before instituting the stopping procedure, see that the following controls are in the positions noted:

Mixture control - - - - -	"FULL RICH"
Propeller control (on quadrant) - - - - -	"INCREASE RPM"
Supercharger control - - - - -	"LOW"
Cowl flap control - - - - -	"OPEN"

If the engine cylinder temperatures are above 149 degrees C (300 degrees F), operate the engine at 1000 rpm, with the cowl flaps "OPEN" until the cylinder head temperature has dropped below 149 degrees C (300 degrees F).

NOTE: In emergency only, the engine may be stopped at higher cylinder head temperatures after throttling to 1200 rpm or less.

Before stopping the engine when a cold weather start is anticipated, place the oil dilution switch in the "OIL DILUTION" position. It is unnecessary to dilute the oil for a starting temperature above -7 degrees C (20 degrees F). If the engine heat is excessive while diluting the oil, the heat may evaporate the fuel out of the oil and leave the viscosity of the oil in the engine unchanged. The engine should therefore be idled with the oil cooler shutters and cowl flaps in their maximum cooling position until the cylinder head temperatures are below 66 degrees C (150.8 degrees F), and the oil-in temperature below 38 degrees C (100.4 degrees F). Should experience indicate that this does not provide sufficient cooling, the engine should be stopped for a short time and then restarted before operating the oil dilution system.

If the engine is equipped with a collapsible ring-type clutch, run the engine for a period of five minutes at 800 to 1000 rpm alternately shifting from "LOW" to "HIGH" and back to "LOW" remaining at each position for 30 seconds. This washes out any accumulation of sludge which may have formed.

Immediately prior to stopping the engine, increase the speed to 1000 to 1200 rpm for a maximum of 30 seconds in order to obtain the most efficient scavenging of the crankcase oil.

Stop the engine by placing the mixture control in the "FUEL CUT-OFF" position (full aft). If oil dilution is employed, hold the switch in the "OIL DILUTION" position until the engine stops turning. The time required for the brief scavenging run-up and stopping of the engine

should be anticipated when oil dilution is employed, so that the desired oil dilution period will be obtained when the engine stops.

Do not stop the engine by turning the fuel selector valve "OFF."

Turn the fuel selector valve "OFF" only after the engine has stopped turning completely.

When the engine has stopped turning, place the ignition switch in the "OFF" position.

Leave the cowl flaps open until the engine has cooled.

m. Service Following Preliminary Ground Run.-

(1) Remove and clean the magnetic sump drain plug, the sump strainer, and main oil strainer. Replace and safety items after cleaning.

(2) Remove and clean the main fuel strainer and carburetor strainer. Replace and safety strainers after cleaning.

(3) Immediately after stopping, drain all the oil from the tank, engine sump, radiator and lines.

Remove and clean the magnetic drainplug and screen in the engine sump. Remove and clean the oil strainer in the left side of the supercharger rear section. Replace and safety the strainers and plug. If an excessive amount of filings are found on the magnetic drain plug the cause must be found and remedied and reported through proper personnel for appropriate action. Refill the oil tank to the desired level.

(4) Pre-oil the engine as outlined in part f. of this section before restarting.

(5) Check to see that all spark plugs are tight. Any loose plugs should be set so that they are firm only. Do not tighten plugs to specified torque when engine is warm or hot.

(6) After the engine has thoroughly cooled, see that the ignition switch is "OFF" and check the tightness of the propeller on the propeller shaft. If the propeller appears loose in anyway it must be partially disassembled and the propeller shaft nut tightened, according to the procedure given in section XII of this Handbook. Reassemble and check the installation after tightening the shaft nut.

(7) Remove the cover from the propeller governor drive pad and install the governor, forward control rod, and governor conduit.

(8) Check the quantity of oil in the oil tank; should be 12 or more U. S. gallons (10 or more Imperial gallons).

n. Final Run and Ground Check.-

(1) Prior to restarting the engine, employ the pre-starting procedure given in part d of this section.

(2) Restart the engine according to the procedure given in part j. of this section.

NOTE: The propeller circuit breaker should be "ON" and the propeller switch in "AUTOMATIC," with the propeller control on the quadrant in full "INCREASE RPM," during all ground operation of the engine, except for propeller checks as noted in the following paragraphs.

(3) Open the throttle to 1200 rpm and run at this speed for 15 minutes, if this can be done without exceeding a cylinder head temperature of 205 degrees C (400 degrees F).

(4) Check the following at 1200 rpm.

Oil pressure - - - - - 75 to 90 pounds per square inch.

Oil temperature - - - - -	55° C to 85° C (131° F to 185° F).
Fuel pressure (each pump) - - - - -	6 to 7 pounds per square inch.
Hydraulic pressure - - - - -	1000 pounds per square inch approximately.
Vacuum - - - - -	4.00 to 5.00 inches mercury.
Cylinder head temperature - - - - -	205° C maximum (400° F).
Operation of fuel selector valve	

(5) Check the manual operation of the propeller at 1200 rpm. With the propeller circuit breaker "ON," place the propeller switch in "DECREASE RPM" until a loss of 200 rpm is noted. Place the propeller switch in "INCREASE RPM" until the engine regains its lost rpm. With the propeller control on the quadrant in full "INCREASE RPM," return the propeller switch to "AUTOMATIC."

(6) Open the throttle slowly to the rpm at which the generator cuts in, and hold at that rpm long enough to check the reverse current relay closing voltage. The relay should close at 26.5 volts. A reading slightly above this value will be normal just after the relay closes. To read the voltage, push the bottom on the volt-ammeter.

The generator should cut in between 1200 and 1300 rpm. The point at which the relay closes will be indicated by a movement of the ammeter pointer in direction of "CHARGE." If the batteries are fully charged, the indicated charging rate will be low.

(7) With the propeller switch in "AUTOMATIC," propeller circuit breaker "ON," and propeller control in full "INCREASE RPM," open the throttle to 2000 rpm but do not exceed 30 inches of mercury. Perform the following:

(a) Check and record the oil temperature and pressure, cylinder head temperature, fuel pressure, and vacuum at 2000 rpm and not over 30 inches of mercury. Check fuel quantity gages.

NOTE: If the cylinder head temperature rises above 205 degrees C (400 degrees F) during the following checks, close the throttle to 1000 rpm and allow the engine to cool.

(b) Make certain that the propeller is in low pitch by placing the propeller switch in "INCREASE RPM." Then place the propeller switch in the "OFF" position. With the throttle at 2000 rpm (do not exceed 30 inches of mercury) check magnetos by switching momentarily from "BOTH" to "LEFT" then back to "BOTH" then to "RIGHT" and back to "BOTH." (Allow the engine to regain its lost rpm after checking the right magneto by switching back to "BOTH.") Check and record the drop in rpm for each magneto. Normal drop is 75 to 100 rpm, and should not exceed 100 rpm. The check on each magneto should be as short as possible to avoid damage from detonation. With the propeller control on the quadrant in full "INCREASE RPM," return the propeller switch to "AUTOMATIC."

(c) Check the automatic operation of the propeller as follows: First, see that the propeller control on the quadrant is in full "INCREASE RPM" position; then, open the throttle to obtain not more than 2000 rpm nor more than 30 inches of mercury. Move the propeller control to the full "DECREASE RPM" position and hold until the engine speed has decreased approximately 200 rpm, then return to full "INCREASE RPM" position and check to see that the original engine speed is regained. Close the throttle to 1700 rpm.

(8) Check the operation of the supercharger. Set the propeller governor in the full "INCREASE RPM" (low pitch) position. With the engine speed at 1700 rpm, move the supercharger control lever to the "HIGH" position and lock. Open the throttle to obtain not over 30 inches of mercury manifold pressure or 2000 rpm. When the engine speed has stabilized, observe the manifold pressure and immediately shift the supercharger to "LOW" position without moving the throttle. A sudden decrease in manifold pressure is an indication that the two-speed supercharger drive is operating properly.

CAUTION: All shifts of the supercharger control should be made directly to the full "HIGH" or "LOW" position without hesitating between the stops.

NOTE: High clutch shifts should not be attempted at engine speeds below 1700 rpm

and, while shifting is permissible at speeds above 1700 rpm, it is recommended that all shifts be effected at 1700 rpm.

Close the throttle to 1000 rpm and allow the cylinders to cool.

(9) See that the propeller control is in full "INCREASE RPM," the mixture control in "RICH" position, the supercharger control in "LOW" position, and open the throttle to 2800 rpm. Observe the tachometer and manifold pressure gage closely. Do not allow the propeller speed to exceed 2800 rpm, or the manifold pressure to exceed 44.3 inches of mercury. The propeller governor should limit the propeller speed to 2800 rpm, when the propeller control is in full "INCREASE RPM" position. Make this check as quickly as possible not to exceed five seconds.

(10) Operate the engine at 1200 rpm for five minutes to allow the cylinders to cool.

(11) Close the throttle to 700 rpm and check the operation of the magneto switch. After the engine has cooled, turn the magneto switch "OFF" momentarily to note that the engine stops firing. Return the switch to "BOTH" immediately. This check must not take more than two seconds.

o. Stopping.- Before instituting the stopping procedure, see that the following controls are in the positions noted:

Mixture Control	-----	full "RICH"
Propeller control (on quadrant)	-----	"INCREASE RPM"
Supercharger control	-----	"LOW"
Cowl flap control	-----	"OPEN"

If the engine cylinder temperatures are above 149 degrees C (300 degrees F), operate the engine at 1000 rpm, with the cowl flaps "OPEN," until the cylinder head temperature has dropped below 149 degrees C (300 degrees F).

NOTE: In emergency only, the engine may be stopped at higher cylinder head temperatures after throttling to 1200 rpm or less.

Before stopping the engine when a cold-weather start is anticipated, place the oil dilution switch in the "OIL DILUTION" position. It is unnecessary to dilute the oil for a starting temperature above -7 degrees C (20 degrees F). If the engine heat is excessive while diluting the oil, the heat may evaporate the fuel out of the oil and leave the viscosity of the oil in the engine unchanged. The engine should therefore be idled with the oil cooler shutters and cowl flaps in their maximum cooling position, until the cylinder head temperatures are below 66 degrees C (150.8 degrees F) and the oil-in temperature below 38 degrees C (100.4 degrees F). Should experience indicate that this does not provide sufficient cooling, the engine should be stopped for a short time and then restarted before operating the oil dilution system.

If the engine is equipped with a collapsible ring-type clutch, run the engine for a period of five minutes at 800 to 1000 rpm, alternately shifting from "LOW" to "HIGH," and back to "LOW," remaining at each position for 30 seconds. This washes out any accumulation of sludge which may have formed. This operation is necessary only when the engine is stopped after the first hour and a quarter of operation and, at the completion of the ground test, to work out the rust-preventive compound.

Immediately prior to stopping the engine, increase the speed to 1000 to 1200 rpm for a maximum of thirty seconds, in order to obtain the most efficient scavenging of the crankcase oil.

Stop the engine by placing the mixture control in the "FUEL CUT-OFF" position (full aft). If oil dilution is employed, hold the switch in the "OIL DILUTION" position until the engine stops turning. The time required for the brief scavenging run-up and stopping of the engine should be anticipated when oil dilution is employed, so that the desired oil dilution period will be obtained when the engine stops.

Do not stop the engine by turning the fuel selector valve "OFF."

Turn the fuel selector valve "OFF" only after the engine has stopped turning completely.

When the engine has stopped turning, place the ignition switch in the "OFF" position.

Place the propeller switch in the "OFF" (center) position.

DO NOT MOVE THE PROPELLER UNTIL THE ENGINE HAS COOLED THOROUGHLY.

4. Normal Engine Operation.

Before starting the engine, be certain that all preflight inspections and checks, required before starting the engine, have been accomplished.

Be certain that there is sufficient fuel and oil in the tanks to complete the intended run.

Service with 100-octane fuel conforming to Specification No. AN-F-28, and oil conforming to Specification No. AN-VV-O-446, grade 1100 or 1120, as required. Never operate the engine with less than 12 U. S. gallons (10 Imperial gallons) of oil in the oil tank.

a. Prestarting Procedure.-

(1) Head the airplane into the wind.

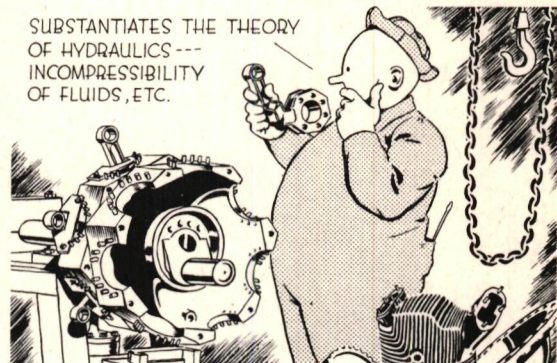
(2) Block both wheels of the airplane with wheel chocks.

(3) Check the hydraulic accumulator pressure. If the pressure is low, open the shut-off valve (item 6, fig. 7-IX) and build up accumulator pressure to 600 pounds per square inch minimum with the hand pump.

(4) Connect a 24-volt cart battery of at least 34-ampere hours capacity to the external power connector.

(5) With the ignition and starter switches "OFF," pull the propeller through, with the throttle wide "OPEN," three or more complete revolutions by hand, to clear the cylinders of fluid that may have accumulated. If there is unusual resistance to turning or if the cylinders are believed to be filled with fluid, remove the spark plugs and intake pipes from the three lowest cylinders. If fluid is found, remove the spark plugs and intake pipes of adjacent cylinders until cylinders are found free of fluid.

Replace spark plugs, spark plug gaskets, intake pipes, and ignition wiring. Tighten plugs to 450 to 500 inch-pounds torque, cold engine.



CAUTION: Serious damage will result if cylinders are filled with fluid when the engine is started.

(6) Check the mechanical starter clutch control to be sure that the clutch is in the full disengaged position.

(7) Be certain that the PROPELLER IS CLEAR.

b. Starting.-

(1) General.-

NOTE: During the ground-run, check the fuel gages at frequent intervals. Never permit the engine to operate on a fuel tank until it becomes dry. It is recommended that the engine be started with the fuel selector valve in a full tank position. However, any fuel tank may be selected during the ground-run as long as it contains sufficient fuel to run the engine without running dry.

The cowl flaps must be open. Closing the cowl flaps may result in cylinder fins cracking, because of temperature differentials, and burning of ignition system insulation.

(2) Position of Controls.- See that the following controls are in the positions noted:

Ignition switch	-----	"OFF"
Starter switch	-----	"OFF"
Fuel gage and howler circuit breaker	-----	"UP(B)"
Primer and oil dilution circuit breaker	-----	"UP(B)"
Starter circuit breaker	-----	"ON"
Battery switch	-----	"BATTERY"
Generator switch	-----	"GENERATOR"
Carburetor heat control	-----	"DIRECT"
Cowl flaps	-----	"OPEN"
Supercharger control	-----	"LOW"
Throttle control, set for	-----	700 rpm to 800 rpm
Mixture control	-----	"FUEL CUT-OFF" *
Propeller control (on quadrant)	-----	full "INCREASE RPM"
Propeller circuit breaker	-----	"ON"
Propeller switch	-----	"AUTOMATIC"
Fuel selector valve control	-----	to a full tank
Emergency fuel pump switch	-----	"EMERGENCY FUEL PUMP"

Check the fuel pressure after the emergency fuel pump is turned "ON"; pressure should be $7-1\frac{1}{2} + 1\frac{1}{2}$ pounds per square inch.

*NOTE: The mixture control for the Holley Carburetor has three definite positions; full "RICH," "CRUISING LEAN," and "FUEL CUT-OFF." The mixture control must be in the "FUEL CUT-OFF" position whenever the engine is not running. To guard against fires, scoring of cylinder walls, or flooding of the lower cylinders, never start the engine with the mixture control in full "RICH," and never prime until the engine is turning over.

(3) Energize Starter.-

(a) Electric Inertia.- Place the starter switch in the "START" position and hold for 20 to 30 seconds to energize the inertia element.

(b) Hand Inertia.- If hand inertia starting is to be employed, insert the hand crank extension and operate until a crank speed of 70 to 75 rpm is attained. Remove the hand crank.

(4) Place ignition on "BOTH."

(5) Engage Starter.-

(a) If electrical energizing was used, place the starter switch in the "MESH" position.

(b) If mechanical energizing was used, either of the following methods may be used:

1. After the mechanic who operated the hand crank has removed the crank, he may pull the meshing cable until the engine fires. After the propeller has turned two complete revolutions, the mechanic in the cockpit must turn the starter switch to the "MESH" position, to supply booster current.

2. When the mechanic who operated the hand crank has removed the crank, he should immediately get clear of the airplane and signal the mechanic in the cockpit to mesh the starter, as described under electrical meshing above.

(6) Prime (if required).- As soon as the starter is engaged and the engine is turning over, place the primer switch in the "PRIMING PUMP" position for a maximum of five seconds if priming is required. Use only sufficient priming to start the engine, giving due consideration to atmospheric and engine temperatures.

NOTE: If the engine becomes over-primed, see that the ignition and starter switches are "OFF," open the throttle wide, and turn the engine over by hand until it is cleared out. When clear, return the throttle to the starting position to give 700 to 800 rpm. Do not attempt to prime the engine by pumping the throttle. The accelerating pump is not mechanically connected to the throttle and therefore cannot be operated in this manner.

(7) Mixture full "RICH," Starter "OFF". - When the engine fires, move the mixture control immediately to the full "RICH" position, and place the starter switch in the "OFF" position.

WARNING: When engine starts, do not open throttle excessively. This will "lean" the mixture, thereby defeating the setting of mixture control. If leaning is excessive, an engine may backfire through the induction system or stop completely.

Backfiring is not to be confused with kickback, which is merely a tendency to reverse the direction of rotation when starting the engine and is caused by a highly advanced ignition timing or pre-ignition.

A backfire is caused by slow flame propagation resulting from a lean mixture, so that the charge is still burning when the cycle is completed (end of exhaust stroke).

As the intake valve opens to admit the fresh charge to the cylinder, it is immediately ignited by the residual flame of the previous cycle. The flame travels back through the induction system burning all the combustible charge, and often will ignite any accumulation of gasoline near the carburetor.

The throttle should not be set above 1000 rpm until engine is running smoothly; in other words, give the engine a chance to become warm enough for proper vaporization of fuel.

CAUTION: Watch oil pressure. If the oil pressure does not rise to 40 pounds per square inch within ten seconds after starting, stop the engine immediately by moving the mixture control to the "FUEL CUT-OFF" position. Turn the ignition switch "OFF" after the engine stops. Do not restart the engine until the cause of the oil pressure failure has been determined and remedied.

(8) Prime as Required. - Prime sparingly as required to obtain smooth operation.

(9) Disconnect Cart Battery. - After the engine has been started, disconnect the cart battery.

(10) Failure of Engine to Start. - If the engine fails to start upon the first attempt, turn the ignition and starter switches "OFF" and repeat the starting procedure. Do not, however, over-prime the engine. If the engine fails to start after a reasonable number of attempts, place the mixture control in the "FUEL CUT-OFF" position, turn the ignition, starter, and other switches "OFF" and check the ignition, fuel, and general power plant installations to determine the trouble. If it is necessary to stop the engine during the preliminary start, the spark plugs may become fouled. It will then be necessary to remove the spark plugs, clean and test them, and repeat the starting procedure after replacing the spark plugs and ignition cables properly.

CAUTION: In case disengagement of the starter and engine jaws did not occur, due to engine compression, turn the propeller by hand (ignition "OFF") one-half revolution in either direction of rotation, to release the starter jaw.

c. Engine Warm-Up and Engine Checks. -

NOTE: Aircraft engines will always be warmed up on the ground, until proper lubrication and engine operation for take-off and flight are assured. During warm-up and ground operation, the following limits for the items noted will apply:

Oil temperature (after warm-up) - - - - -	55° - 85° C
	131° - 185° F
Oil pressure (except idle) - - - - -	75-90 lb/sq in.

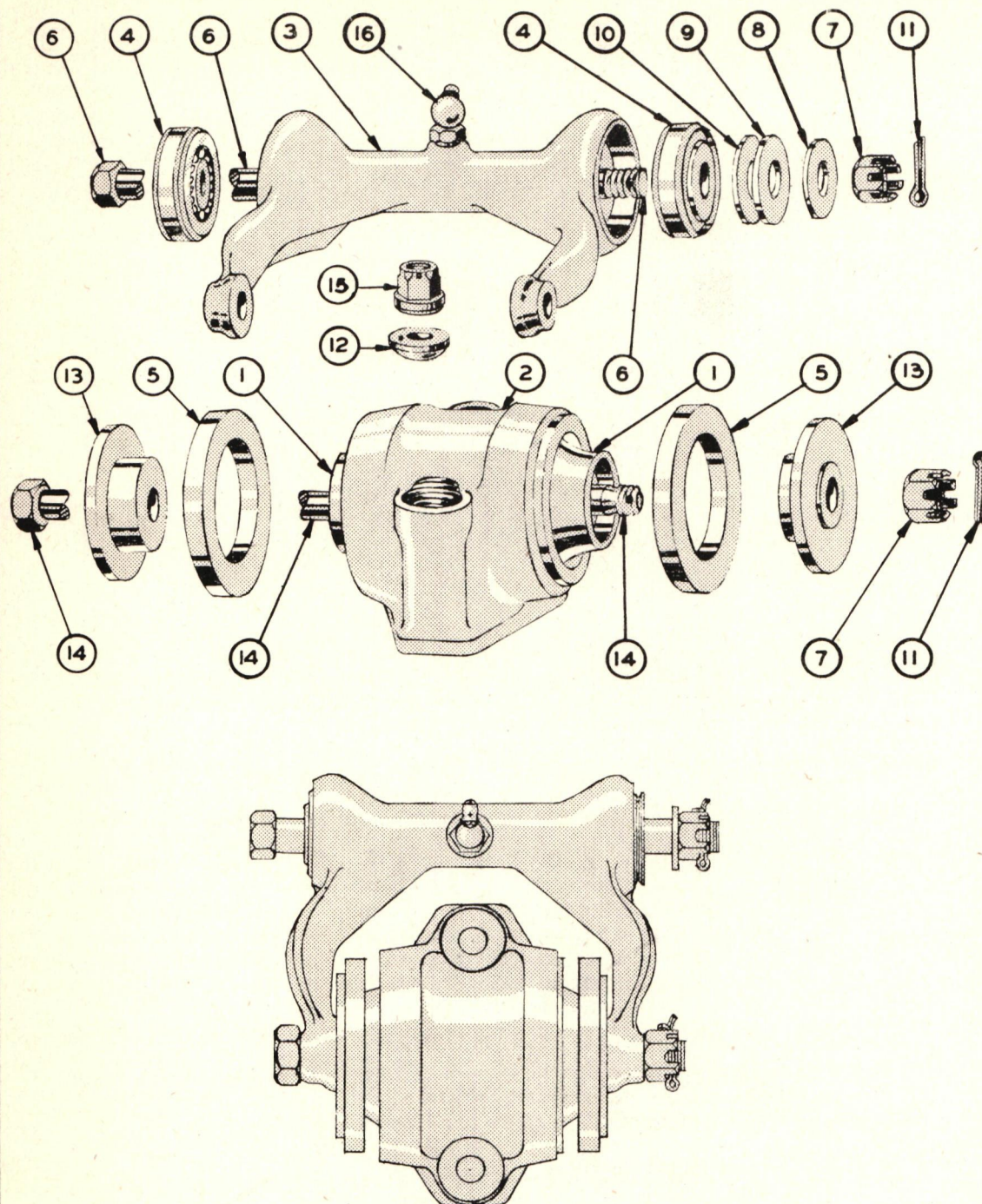


Figure 8-XIII - Lord Dynafocal Assembly RL-25

PARTS LIST - LORD DYNAFOCAL ASSEMBLY RL-25

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Dynafocal Rubber Mounting	RL-25-1
2	1	Dural Bracket (Supersedes RL-25-2)	RL-25-2A
3	1	3-inch Link	RL-25-3
4	2	Tapered Roller Bearing	RL-25-4
5	2	Rubber Snubbing Washer	RL-25-5
6	1	Bearing Bolt 4713 inch diameter x 6-3/64 inches	RL-25-6
7	2	Slotted Hex Nut (7/16 inch - 20 NF-3)	RL-25-7
8	1	Washer for Bearing Bolt (3/32 inch)	RL-25-8
9	As Req'd.	Shim for Bearing Bolt (.013 inch)	RL-25-9
10	As Req'd.	Shim for Bearing Bolt (.012 inch)	RL-25-10
11	2	Cotter Pin (086 inch x 3/4 inch)	RL-25-11
12	2	Spherical Washer (Supersedes RL-25-12)	RL-25-18
13	2	Mounting End Plate	RL-25-13
14	1	Mounting Bolt (7/16 inch x 5-5/32 inch)	RL-25-14
15	2	Special Drilled Nut (7/16 inch - 20NF3)	RL-25-16
16	1	Grease Fitting	RL-25-17

NOTE: Use lock wire as required.

Oil pressure (idle) - - - - - 25 lb/sq in.
 Cylinder head temperature
 (below 2000 rpm) - - - - - 205° C (400° F) maximum
 Fuel pressure - - - - - 6-7 lb/sq in.

(1) When the engine fires smoothly, gradually open the throttle to 1200 rpm. Give the engine a thorough warm-up with the propeller control in full "INCREASE RPM."

(2) Run the engine at 1200 rpm until the oil inlet temperature reaches 55 degrees C (131 degrees F), or in cold weather until an oil temperature rise of 10 degrees C (18 degrees F) is obtained.

(3) Watch the oil pressure gage for fluctuations in pressure caused by air trapped in the oil lines. Any air so trapped should be allowed to escape by extending the warm-up period until the oil pressure stabilizes.

(4) Be sure the cowl flaps are open.

(5) See that the wing flaps are in normal take-off position.

(6) Set elevator trim tabs in normal take-off position.

(7) Check aileron and rudder tabs for normal flight setting.

(8) Operate rudder, elevator, and aileron controls to assure that there is no binding or interference.

(9) Check landing gear position indicators. Only the landing gear flag (farthest inboard) should be up.

(10) Check all instrument mounts for excessive vibration and instruments for excessive pointer oscillation.

(11) Check compass for proper operation.

(12) Check oil pressure.

(13) Check bars and pointers of bank and turn and flight indicators after five minutes of operation of vacuum pump at 1200 rpm.

(14) After the engine has been given a thorough warm-up, open the throttle to not more than 30 inches of mercury manifold pressure and, with an engine speed not in excess of 2000 rpm, check the oil and cylinder temperatures and the oil, fuel, and manifold pressure.

While operating at 2000 rpm but not over 30 inches of mercury, perform the following:

NOTE: If the cylinder head temperature rises above 205 degrees C (400 degrees F) during the following checks, close the throttle to 1000 rpm and allow the engine to cool.

(a) Ascertain that the propeller is in low pitch by placing the propeller switch in the "INCREASE RPM." Then place the propeller switch in the "OFF" position. Open the throttle to 2000 rpm but do not exceed 30 inches of mercury and check magnetos by switching momentarily from "BOTH" to "LEFT" then back to "BOTH," then to "RIGHT" and back to "BOTH." Allow the engine to regain its lost rpm after checking the left magneto. Before checking the right magneto by switching back to "BOTH," check and record the drop in rpm for each magneto. Normal drop is 50 to 75 rpm, and should not exceed 100 rpm. The check on each magneto should be as short as possible to avoid damage from detonation. With the propeller control on the quadrant in full "INCREASE RPM," return the propeller switch to "AUTOMATIC."

(b) Check the automatic operation of the propeller as follows: First, see that the propeller control on the quadrant is in full "INCREASE RPM" position, then open the throttle to obtain not more than 2000 rpm nor more than 30 inches of mercury. Move the propeller control to the full "DECREASE RPM" position and hold until the engine speed has decreased approximately 200 rpm; then return to full "INCREASE RPM" position and check to see that the original engine speed is regained. Close the throttle to 1700 rpm.

(15) Check the operation of the supercharger as follows: Set the propeller governor in the full "INCREASE RPM" (low pitch) position. With the engine speed at 1700 rpm, move the supercharger control lever to the "HIGH" position and lock. Open the throttle to obtain not over 30 inches of mercury manifold pressure or 2000 rpm. When the engine speed has stabilized, observe the manifold pressure and immediately shift the supercharger to "LOW" position without moving the throttle. A sudden decrease in manifold pressure is an indication that the two-speed supercharger drive is operating properly.

CAUTION: All shifts of the supercharger control should be made directly to the full "HIGH" or "LOW" position without hesitating between the stops. Do not shift the supercharger control to "HIGH" blower ratio below 1700 rpm and then open the throttle.

NOTE: The following check is not necessary prior to each flight, but should be accomplished during the preliminary warm-up period at the start of the day's flying.

Close the throttle to 700 rpm. Momentarily turn the magneto switch "OFF" to note whether or not the engine stops firing. Immediately return the switch to "BOTH." This check should be accomplished in two seconds or less.

CAUTION: Ground tests and warming-up periods should be held to a minimum consistent with safe operation of the engines. Engines will be stopped rather than idled for prolonged periods after warm-up has been accomplished.

d. Stopping. - Before instituting the stopping procedure, see that the following controls are in the positions noted:

Mixture control	- - - - -	Full "RICH"
Propeller control (on quadrant)	- - - - -	"INCREASE RPM"
Supercharger control	- - - - -	"LOW"
Cowl flap control	- - - - -	"OPEN"

If the engine cylinder temperatures are above 149 degrees C (300 degrees F), operate the engine at 1000 rpm, with the cowl flaps "OPEN" until the cylinder head temperature has dropped below 149 degrees C (300 degrees F).

NOTE: In emergency only, the engine may be stopped at higher cylinder head temperatures after throttling to 1200 rpm or less.

Before stopping the engine when a cold weather start is anticipated, place the oil dilution switch in the "OIL DILUTION" position. It is unnecessary to dilute the oil for starting temperature above -7 degrees C (20 degrees F). If the engine heat is excessive while diluting the oil, the heat may evaporate the fuel out of the oil and leave the viscosity of the oil in the engine unchanged. The engine should therefore be idled with the oil cooler shutters and cowl flaps in their maximum cooling position until the cylinder head temperatures are below 66 degrees C (150.8 degrees F) and the oil-in temperature below 38 degrees C (100.4 degrees F). Should experience indicate that this does not provide sufficient cooling, the engine should be stopped for a short time and then restarted before operating the oil dilution system.

If the engine is equipped with a collapsible ring-type clutch, run the engine for a period of five minutes at 800 to 1000 rpm, alternately shifting from "LOW" to "HIGH" and back to "LOW," remaining at each position for 30 seconds. This washes out any accumulation of sludge which may have formed.

Immediately prior to stopping the engine, increase the speed to 1000 or 1200 rpm for a maximum of thirty seconds in order to obtain the most efficient scavenging of the crankcase oil.

Stop the engine by placing the mixture control in the "FUEL CUT-OFF" position (full aft). If oil dilution is employed, hold the switch in the "OIL DILUTION" position until the engine stops turning. The time required for the brief scavenging run-up and stopping of the engine should be anticipated, when oil dilution is employed, so that the desired oil dilution period will be obtained when the engine stops.

Do not stop the engine by turning the fuel selector valve "OFF."

When the engine has stopped turning, place the ignition switch in the "OFF" position.

Place the propeller switch in the "OFF" (center) position.

Turn the fuel selector valve "OFF" after the engine has stopped turning completely.

Leave the cowl flaps open until the engine has cooled thoroughly.

DO NOT MOVE THE PROPELLER UNTIL THE ENGINE HAS COOLED THOROUGHLY.

e. Trouble Shooting - Wright Model R-2600-8 Engine.-

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Failure of engine (a) Lack of fuel.		1. Check fuel in tanks. Set selector valve on tank containing sufficient fuel. Disconnect fuel line at carburetor. Start emergency pump. If fuel is discharged, check screen in carburetor. If trouble is still in fuel or carburetor systems, consult "Trouble shooting carburetor."
(b) Underpriming.		1. Lines plugged. Clean primer screen. (Disconnect fuel primer line at right side of engine induction housing.) If fuel here, remove and clean three primer spray nozzles, two on engine induction housing and one on supercharger housing. Operate manual push button on primer body. 2. Operate primer switch and listen for opening and closing of solenoid. If no sound, disconnect cannon plug and test wiring contacts with light.
(c) Overpriming.		1. Solenoid defective or needle valve not seating properly. Flush by rapid operation of solenoid switch.

IMPORTANT: If valve does not cut off completely, replace it.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
		2. Do not prime more than necessary. This will be governed by engine temperature, weather conditions, and experience.
(d) Booster coil defective.		<u>1.</u> Set number one piston 20 degrees before top center on compression stroke. (Quickest way is to remove magneto breaker cover and line up marks as shown at fig. 1-XIV with straight edge.) <u>2.</u> Remove cannon plug from starter. <u>3.</u> Remove number six spark plug wire and hold one-eighth inch from cylinder head. (Booster brush "trails" magneto brush.) <u>4.</u> Mesh starter and see if spark occurs at gap. Also listen for "buzz" of vibrator.
(e) Throttle opening incorrect.		<u>1.</u> The throttle must be set for 700 rpm to 800 rpm. (This can be determined by experience as there is usually a slight difference of quadrant setting on different engines.)
(f) Mixture control.		<u>1.</u> See that mixture control is not set in "CRUISING LEAN" position. Should be set in "FUEL CUT-OFF" but will start in full "RICH" position.
(g) Defective ignition wire.		<u>1.</u> Examine wire for breaks, excessive wear, and incorrect connections. (If harness tester is used, adhere to instructions found with the equipment to avoid damaging the wire by excessive voltage.)
(h) Spark plugs.		<u>1.</u> Check plugs for cleanliness and proper spark gap. See fig. 1-XIV for gage. Study section XIV for proper care of spark plugs.
(i) Incorrect valve tappet clearance.		<u>1.</u> Check clearance and set at .010 inch on cold engine. If valve has been riding too tight on roller, valve will probably have to be replaced and re-ground. The valve clearance adjusting screw is marked on its outer face in line with each of the three radially drilled oil holes in the screw. The upper eight rocker arms of each bank of cylinders are pressure lubricated, so the following precautions must be observed not to allow an oil hole, as indicated by the marking on the outer face of the adjusting screw, to line up with the split in the rocker arm, and thus discharge pressure oil to the rocker box. The marks on the face of the adjusting screw must indicate that all oil pressure holes are blanked off by a distance of at least 3/32 inch from the nearest split edge of the rocker arm. If adjusting the valve clearance to .010 inch causes any mark to fall outside the limit, turn the adjusting screw in the shortest direction that will bring it within limits and tighten the locking cap screw. If the marking is directly in line with the split in the rocker arm, increase rather than decrease the valve clearance.

- (j) Incorrect valve timing.
1. Set piston on top dead center in number one cylinder.
 2. Set intake valve tappet to .070 inch. (Hot engine clearance.)
 3. Turn crankshaft in direction of rotation until intake valve starts to tighten against rocker arm roller.
 4. Take reading on bell gear in nose section. This should be 20 degrees before top center. If the reading is two or three degrees either side, it is all right as one tooth out of time is equivalent to 30 degrees.
 5. Turn engine in direction of rotation until piston in number one cylinder is on top dead center and reset valve tappet to .010 inch. (Cold engine clearance.) This is a check on the rear bank of cylinders. To check front bank, proceed as for rear bank by removing starter and using timing disc on starter and using timing disc on starter drive. Always time valves on numbers one and twelve (master rod) cylinders.
- (k) Water in carburetor.
1. Remove the drain plug at the base of the fuel control unit to drain off gasoline and water.
- (l) Cold oil.
1. With the ignition switches "OFF" and mixture control in "IDLE CUT-OFF," turn the engine over by hand. If it is very stiff, it will be necessary to drain and heat the oil before starting.
- (m) Magneto breaker points.
1. See that the breaker points are clean and properly adjusted. Test the spark delivered by the magneto. Care should be exercised in opening the breaker points. Refer to section XIV, Ignition.

NOTE: The oil sump drain plug is equipped with a permanent magnet on the threaded end which is used as a means of trapping foreign particles in the oil sump. If some internal trouble is suspected, this drain plug should be removed and any trapped particles examined.

- (2) Low oil pressure.
- (a) Lack of oil.
1. Check oil in tank.
- (b) Pump coupling spline sheared.
1. Disconnect suction line at pump. Holding thumb over pump inlet, have engine turned in direction of rotation by hand. There should be a decided suction. If not, replace pump.
- (c) Leak in suction lines.
1. Examine the oil suction lines for air leaks.
- (d) Dirt in oil screens.
1. Remove and clean.
- (e) Air lock or dirt on the seat of oil pressure relief valve.
1. Removing and replacing relief valve will often free the oil for circulation.
- (f) Improper setting of relief valve.
1. Adjust the oil pressure relief valve to obtain pressure specified in part u. of this section. If this

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
		pressure is not reached until the screw is all the way, or nearly all the way down, the trouble lies somewhere else. Adjustment of the pressure must be made with the engine running and should be made when the oil is hot.
(g) Oil inlet check valve sticking.		1. Remove and check for freedom of movement of the piston in its guide and make sure the vent passage behind the piston is not obstructed.
(h) Excessive bearing clearance.		1. A bearing may be worn enough to lower the pressure, in which case, an overhaul will be necessary. This will be evidenced by a decided knock.
(i) High oil temperature.		1. Excessive temperatures reduce the viscosity of the oil, which then passes the bearings more freely and tends to drop the oil pressure. Check the oil cooler shutters for opening and check the cooler for clogging.
(j) Low outside temperature.		1. In very cold weather, the oil may become congealed in the suction line from the oil tank, thus preventing the oil from reaching the pump.
(k) Foaming in oil supply tank.		1. Foaming is a frequent cause of fluctuating oil pressure and loss of pressure. The presence of air in the scavenge oil is normal. The return oil from the engine should be directed into the supply tank in such a manner as to produce a minimum of splashing, and to permit air which may be trapped in the return line to separate from the oil as readily as possible. If foaming is experienced, the oil should be removed from the system and the system cleaned. It should be remembered that the pressure will vary with the varying engine speeds and oil temperatures, and due allowance should be made for the pressure drop to be expected at increased temperatures.
(3) Oil accumulation in crankcase.	(a) Air in scavenge pump.	1. Disconnect the main discharge line from the engine and install a short length of rubber hose. While turning the engine backward, feed oil into the hose until a quart or more has been sucked in. Check the oil pump, strainers, and lines for failures or stoppage. 2. Oil accumulation in the engine crankcase may also be due to high oil inlet temperature or pressure. Suggestions for determining the cause of excessive inlet temperature are listed in paragraph 4 of this section. If high pressure appears to be the cause, the oil relief valve should be checked and corrected.
(4) Excessive oil temperature. High oil consumption.	(a) Insufficient oil cooling.	1. Check radiator and control valve. Oil valve at radiator set for operating temperature of 80 degrees C (176 degrees F).
	(b) Insufficient oil supply.	1. Check oil in tank. Clean screens. Disconnect oil return line at tank and observe for free oil flow.
	(c) Overheated bearing.	1. Return to base for overhaul.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
	(d) Suction pump failing to scavenge properly from crankcase.	1. Dirt in screens; clean. Air locked; see (d) above.
	(e) Dirty oil.	1. Change oil and clean screens.
	(f) Worn piston rings.	1. Return to base for overhaul.
	(g) Piston rings incorrectly installed (upside down).	1. Return to base for overhaul.
	(h) Improper venting of oil system.	1. Vent system and clean screens.
	(i) Clogged oil lines, strainers, cooler.	1. Clean system thoroughly.
(5) Low power and uneven running.	(a) Too rich or too lean a mixture.	1. Adjust fuel mixture as specified.
	(b) Leaks in induction system.	1. Check for leaks or cracks at intake pipes, cylinders, crankcase connections, carburetor, and adapter flanges.
	(c) Spark plugs.	1. See section XIV of this Handbook.
	(d) Valve and valve gear trouble.	1. Check the valve tappet clearance, springs, washers, rocker arms, and push rods. Make sure valves are not sticking.
	(e) Faulty magnetos.	1. Check breaker points for adjustment and cleanliness. 2. Change magneto. See section XIV.
	(f) Ignition wire bad.	1. Check for break or ground.
	(g) Ice in carburetor.	1. Check by using carburetor air heat.

TORQUE VALUES

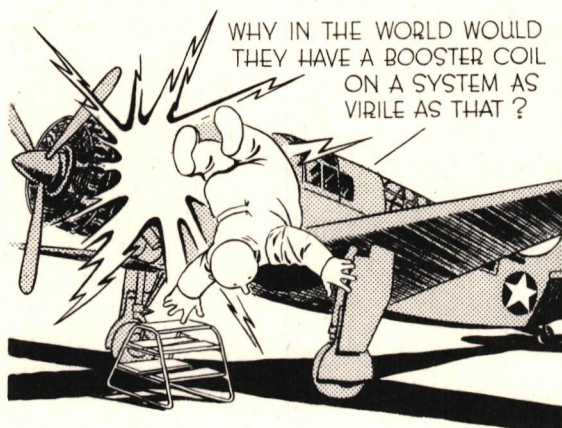
	Sizes	In Lbs. Min.	Max.
Studs, Bolts, Screws and Cap Screws	10/32	35	40
	12/24	45	50
	1/4-28	80	85
	5/16-24	160	175
	3/8-24	225	250
	7/16-20	350	375
	1/2-20	550	600
	9/16-18	325	875
	5/8-18	1125	1200
Cylinder Hold-Down Nuts or Cap Screws		350	375
Rocker Hub Bolts	9/16-18	300	375
Spark Plugs (Cold)		450	500

Section XIV

IGNITION SYSTEM

1. General.

Ignition is supplied by two Bendix-Scintilla SF14LN-3 magnetos attached to the supercharger rear cover. The ignition switch is located just aft of the fire wall on the left side of the pilot's cockpit. Blast tubes are provided for cooling each magneto. Ignition wire is rubber insulated and covered with a coating to prevent wear and deterioration. A manifold, extending around the outside of the crankcase front section parting flange, conducts the wires to the base of each cylinder from which point they are led up to the front and rear spark plugs. All parts of the ignition system are shielded to eliminate radio interference. The shielding is constructed so that any damaged part may be replaced without discarding the entire assembly. The front leads are open to the cooling air, and the rear spark plugs and leads are cooled by ducts which are part of the head baffles. Suitable clips keep the shielded wire from chafing on the cylinders.



A booster coil is placed in the system to aid in starting the engine. The high tension lead from this coil is connected to the distributor rotor of the right-hand magneto. The booster electrode is located so that it trails the high tension segment on the distributor finger to give a retarded spark for starting the engine.

The principal parts of the ignition system are the magnetos, booster coil, ignition switch, cable assemblies, and spark plugs.

2. Magnetos, Bendix-Scintilla SF14LN-3.

a. Description.- The Bendix-Scintilla SF14LN-3 magneto incorporates a pivotless-type

breaker, an eight-lobe rotating magnet, and a stationary coil. The magneto is driven at $7/8$ crankshaft speed. The breaker cam has 14 lobes and is driven at $1/2$ crankshaft speed. The lobe for firing No. 1 cylinder is identified by a timing dot engraved adjacent to it.

The pivotless type breaker is designed for high speed operation. Its construction provides a means for conveniently making inspections and adjustments, if necessary. The contact points are made of a platinum-iridium alloy which gives long service life. Lubrication of the cam follower is obtained by means of a felt which is kept moist with oil.

The magnet rotates in two ball bearings, one located at the breaker end shaft and the other at the drive shaft end. These bearings are packed with a high temperature grease, Specification No. AC-3560, medium grade, and do not require lubrication between engine overhaul periods. The breaker cam, which actuates the contact points, is driven from the magnet shaft extension at the breaker end. A step is cut in the cam for timing purposes, and the flanks adjacent to the lobes also have grooves to serve as a lubricant reservoir and assist in keeping the cam follower felt in a moist condition.

The small distributor gear, located on the drive shaft extension, drives the large distributor gear and distributor finger. These gears are designed so that the high tension current from the coil is conducted to the distributor block electrodes, and thence through the high tension cables to the spark plugs at the correct firing interval of the engine. The high tension current is conducted from the coil through the medium of a carbon brush to the distributor finger segments. High temperature grease, Specification No. AC-3560, medium grade, is applied to the distributor gears and further lubrication is not necessary except at overhaul periods.

b. Removal.- The SF14LN-3 magneto has a detachable distributor block shrouded by a two-piece radio shield. Radio shields for right hand and left hand differ slightly, each having the outlet to the ignition wire shielding on the outboard side of the magneto. In view of the fact that

all of the high tension wires are secured to the distributor blocks, the block and radio shield of a magneto (being removed) are also used on a replacement magneto of the same type, unless the block requires repair. The magneto cover encloses the coil and internal parts, and contains the ground wire terminal. It may also be used on a replacement magneto of the same type without disconnecting the ground terminal.

Remove the safety pin from the clamp screw holding the two magneto coil cover securing straps. Unscrew the clamp screw and swing the securing straps to the rear. The clamp screw is retained in the outboard strap with a circlip and need not be removed. Slide the magneto coil cover off to the rear to clear the pilot on the distributor block radio shielding. The coil cover, with the magneto ground wire attached to it, may be moved out of the way until ready for installation on the replacement magneto.

Remove the two long hex-head cap screws which secure the distributor block and radio shield assembly to the front end plate of the magneto. These screws are approximately in line with, and at each end of, the horizontal pilot flange for the magneto coil cover. Lift the distributor block and shield assembly from the magneto by pulling it slightly to the rear, to clear the front end plate pilot, and then upwards. Move the assembly out of the way until ready for installation on the replacement magneto.

Unscrew the two hex-head cap screws which secure the breaker cover to the magneto housing and remove the cover. This exposes the 14-lobe cam and pivotless contact breakers in the breaker housing.

With the ignition switch "OFF" and mixture control in "FUEL CUT-OFF," turn the engine crankshaft in the direction of normal rotation until the step, cut in the breaker cam (L), lines up with the timing marks (M) and (N) cut in the rim of the breaker cup, as indicated by a straight edge (K) (preferably a steel scale). At this point, the timing mark (A) on the distributor rotor will coincide with the marker (B) on the magneto front end plate indicating that the rotor is in a position to distribute a spark to No. 1 cylinder. See fig. 1-XIV.

Procedure (1), following, should be followed in removing a magneto in the event that the timing plug hole in the nose section is not accessible. If the timing inspection hole in the nose section is accessible, procedure (2), following, is the easiest and preferred method.

(1) Insert a piece of .001-inch steel feeler stock between the contact points (C) by lifting the felt-covered cam follower (F) which causes the points to open. If the breaker spring itself is lifted to insert a feeler between the points, a permanent set may result from excessive bending. If the points have already begun to open, insert the feeler stock and turn the engine crankshaft slightly in the opposite direction or continue with the rotation in the normal direction, until the breaker points are closed with the felt-lined follower resting on the flat of the cam preceding the lobe, which opens the breaker points to furnish No. 1 cylinder with its firing spark. Now turn the engine slowly in the direction of normal rotation and pull lightly on the feeler stock. Stop turning the engine at the instant the feeler stock starts to slip, indicating that the breaker points are opening. **DO NOT DISTURB THE ENGINE CRANKSHAFT SETTING THUS OBTAINED UNTIL THE REPLACEMENT MAGNETO HAS BEEN INSTALLED.** Remove the cotter pins, castellated nuts, and washers from each of the three magneto attaching studs, holding the magneto to keep it from accidentally dropping, due to its overhanging construction.

(2) If the timing inspection hole in the nose section is accessible for installing the replacement magneto, the inoperative magneto may be removed as soon as its timing marks have been aligned according to the preceding instructions. Remove the cotter pins, castellated nuts, and washers from each of the three magneto attaching studs, holding the magneto firmly to keep it from accidentally dropping because of its overhanging construction.

c. Adjustment of Breaker.- A new or overhauled magneto normally will have the breaker correctly timed when received for installation on the engine. A magneto that has been in service may require readjustment of the breaker due to wear of the cam follower. In every case, the breaker timing should be checked, and adjusted if necessary, with respect to the magneto cam, either prior to installation on the engine or after installation, but before timing the magneto itself to the engine. Do not time the magneto to the engine by adjusting the breaker. This is important. The breaker must be properly timed with respect to the magneto cam to obtain maximum spark intensity. If the breaker opens early or late, beyond a permissible tolerance

with respect to the proper cam position, the spark will not occur at peak power (current and voltage).

Also, in this connection, it should be noted that the breaker is never adjusted for any fixed clearance between contact points.

To check the breaker adjustment, refer to fig. 1-XIV and proceed as follows.

Place a straight edge against the step cut in the cam.

Rotate the crankshaft or magneto shaft, as the case may be, until the edge of the straight edge (K) on the cam step coincides with the timing marks (M) and (N) on the breaker end of the housing. With the cam in this position, the breaker points should just begin to open. The permissible tolerance from the edge of the straight edge (K) to the point (N), when the points start to open is 1/32 inch. If the breaker does not start to open within this tolerance, refer to fig. 1-XIV and adjust as follows:

Loosen the two screws (O) which fasten the movable contact support to the breaker plate. Adjust the movable contact point by means of the eccentric screw (P) so that the points just begin to open when the edge of the straight edge (K) coincides with the timing marks (M) and (N). Tighten the two screws (O) after the correct setting has been made, and then re-check to make sure that the breaker starts to open within the permissible tolerance of 1/32 inch, as described in the preceding paragraph.

When making the foregoing check or adjustment, the position at which the breaker points begin to open can be conveniently checked by placing a strip of .001-inch steel feeler stock between the points and pulling against it slightly. When the shim stock can be released with a slight pull as the cam turns, the contact points are just beginning to open.

When opening the contact points to insert the shim stock, or when inspecting the points, do not raise the breaker mainspring beyond a point giving 1/16-inch opening of the points. Opening the points more than this amount will overstress the mainspring and cause unsatisfactory operation of the magneto.

To check the breaker mainspring for proper tension, employ Bendix-Scintilla gage No. 4-9713 or a spring tension gage of zero to three or four pounds range graduated in one-ounce increments. Place the hook of the gage under the mainspring just outside the contact point, as indicate by the arrow point from the tension note on fig. 1-XIV. If the mainspring has been in operation and the indicated tension required to open the points is 15 to 32 ounces, the mainspring is satisfactory for further service. However, if the indicated tension is below 15 ounces, a new mainspring must be installed and its indicated tension after installation must be from 20 to 32 ounces to open the points. The shims (Bendix-Scintilla No. 10-3768) are installed under the mainspring primarily to line up the contact points squarely. The number of shims used, however, will effect the mainspring tension; the greater the number of shims, the less the tension will be and vice versa.

If, upon inspection, the contact points are pitted or burned, do not attempt to use a file for dressing purposes. To obtain satisfactory results, the contact points must be removed and placed in a suitable block (Bendix-Scintilla No. 4-12176) after which they can be smoothed and polished by means of a special file and stone.

d. Installation and Timing to Engine.- Remove the coil cover, distributor block, and breaker cover from the replacement magneto. Scintilla pivotless-type contact breakers, used in this series of magnetos, must always be adjusted so that the contacts open at the proper position of the breaker cam in relation to the timing marks in the rim of the breaker cup, and not for any

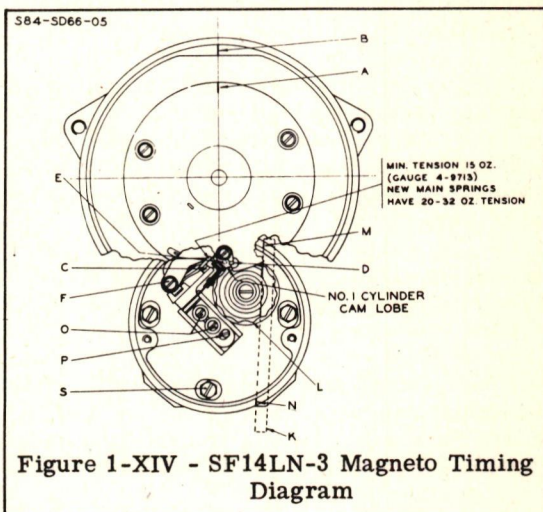


Figure 1-XIV - SF14LN-3 Magneto Timing Diagram

fixed clearance between contacts. Before installing the replacement magneto, first check the adjustment of the breaker contacts as follows:

(1) Lift the cam follower (F) and wipe the contact points with a clean cloth moistened with unleaded gasoline. Do not allow the gasoline to come in contact with the felt-covered follower as this would thin the oil in the felt.

(2) Turn the magneto drive shaft in the direction of normal rotation until the step cut in the breaker cam (L) lines up with the timing marks (M) and (N) cut in the rim of the breaker cup, as indicated by a straight edge (K) (preferably a steel scale). See fig. 1-XIV for designated details. At this point the timing mark (A) on the distributor rotor will coincide with the mark (B) on the front end plate, indicating that the rotor is in a position to distribute a spark to No. 1 cylinder.

(3) Insert a piece of .001-inch steel feeler stock between the contact points (C) by lifting the felt-covered cam follower (F) which causes the points to open. If the breaker spring (C) itself is lifted to insert a feeler between the points, a permanent set may result from excessive bending. If the points have already begun to open, insert the feeler stock and turn the magneto drive shaft slightly in the opposite direction until the breaker points are closed. Now turn the shaft in the direction of normal rotation and pull lightly on the feeler stock. Stop turning at the instant the feeler stock starts to slip, indicating that the breaker points are just opening. Place the straight edge against the face of the step cut in the cam and check the alignment with the timing marks (M) and (N) in the rim of the breaker cup.

(4) If the straight edge does not coincide with the timing marks, turn the magneto shaft until the alignment is made, keeping the .001-inch feeler stock between the points. Loosen the two screws (O) which fasten the breaker assembly to the breaker housing. Hold the magneto shaft in aligned position and adjust the eccentric (P) so that the contact points are just beginning to open. Tighten the securing screws (O) and recheck the adjustment.

With the adjustment thus obtained, the poles of the rotating magnet are in the position at which the maximum energy has been stored in the magnetic circuit. When the breaker points open, a high tension spark is delivered to the spark plug.

If the timing plug on the left-hand side of the nose section is accessible, break the safety wire and remove the plug with its copper-asbestos gasket. If the crankshaft has not been disturbed since the magneto was removed, following the procedure given in preceding part B (2), the position in No. 1 cylinder should be near the top of its compression stroke. By looking through the timing inspection hole, a crank angle degree scale, which is etched on the rim of the reduction driving gear, is seen. This scale ranges from 0 degrees to 35 degrees before top center of No. 1 piston. Move the propeller until the line scribed on the rear of the timing inspection hole indicates that the No. 1 piston is located at 20-crank angle degrees before top center.

If the timing plug hole in the nose section is not accessible, the crankshaft setting obtained prior to the magneto removal should be used for the installation of the replacement magneto.

Apply a heavy grade of petrolatum to the splines of the magneto drive shaft coupling. With the distributor rotor held in the position to fire No. 1 cylinder, install the magneto on the super-charger housing rear cover mounting pad. Having the splined magneto coupling inserted into the mating splined end of the engine magneto drive gear, move the magneto to its extreme position allowed by slots in the mounting flange, noting if the breaker points open and close. If the breaker points open and close, assemble a flat washer and a castellated nut on each of the three attaching studs sufficiently tight to hold the magneto firmly on the cover, but not tight enough to prevent adjusting the position of the magneto.

If the points do not open and close when moving the magneto from side to side, withdraw it from the engine. Install the magneto coupling wrench over the splined drive shaft coupling to keep the shaft stationary, and remove the cotter pin, castellated nut, and washer which retain the coupling on the shaft. The coupling, which is fitted to the shaft by six slots on its inside diameter, should be withdrawn, turned to the next slot engaging position, and re-installed on the shaft. Install the retaining washer and nut and check the opening and closing of breaker points with the magneto on the engine. When the results are satisfactory, withdraw the magneto to in-

stall the cotter pin in the coupling retaining nut, and re-install the magneto on the engine as directed in the preceding paragraph. All adjustments must be made at the drive end of the magneto by changing the location of the coupling splines and not by altering the breaker point opening adjustment.

Move the magneto in the direction opposite to crankshaft rotation until the breaker points open and insert a strip of .001-inch steel feeler stock between them. Move the magneto as far as it will go in the direction of crankshaft rotation so that the breaker points have closed on the feeler stock. Tap the magneto slowly back in the other direction and pull lightly on the feeler stock until it starts to slip, indicating that the breaker points are just beginning to open. Tighten the three flange attaching nuts to secure the magneto at this location.

Check the setting by turning the propeller backward about a quarter of a revolution and re-installing the strip of .001-inch feeler stock between the breaker points. Move the propeller forward slowly, stopping when the feeler strip is released from the breaker points. The crank angle degree reading, observed on the rim of the reduction driving gear through the nose section timing plug hole, should correspond to the engine data plate spark advance at the instant the feeler strip is released. Install the cotter pins in the magneto flange attaching nuts when the correct spark advance setting has been established.

Install the plug in the timing inspection hole in the nose section with the copper-asbestos gasket under its head. Tighten and safety wire the plug.

Install the breaker housing cover and tighten the two hex-head cap screws which are retained in the cover by circlips. Make sure there is a lock washer under the head of each cap screw.

Make sure that the carbon brush and the high tension contact button in the center of the distributor block are free and are loaded by their springs. Depress the contact button and insert the distributor block, complete with the radio shield, into the magneto, and secure the shield to the front end plate with its two long hex-head cap screws, having a lock washer and a plain washer under the head of each.

Slide the magneto coil cover, complete with ground terminal wire, into position on the magneto. Swing the securing straps into place over the top of the cover and tighten the clamp screw. Insert the safety pin in the drilled portion of the screw adjacent to the head.

e. Magneto Distributor Block Removal.- As has been pointed out in part (b) of this section, it is not necessary to remove the distributor block from the spark plug ignition cables when replacing a magneto in the field. However, should the occasion arise where it is necessary to remove the distributor block, the following procedure should be adhered to:

(1) Remove the magneto coil cover and the shielded distributor block from the magneto, following the instructions of part (b) of this section.

(2) Break the safety wire and remove the two hex-head cap screws in the front of the shield outlet which holds the ignition cable shielding to the distributor shield. Loosen the two hex-head cap screws near the base of each half of the distributor shield which secure the distributor block, but do not remove them unless their lock washers are missing. The threaded end of the screws fit normally in the distributor block but have a tight fit in the radio shields. Remove the nuts and washers from the two clamping bolts holding the split halves of the distributor shield together and withdraw the bolts. The shield may then be disengaged from the distributor block in two pieces.

(3) Remove the fourteen cable-piercing screws adjacent to the electrodes in the distributor block and withdraw the spark plug ignition cables. Withdraw the booster cable, if provided, by removing its piercing screw from the deep hole near the center of the block. No lock washer will be found under any screw which pierces an ignition cable.

f. Magneto Distributor Block Installation.- Remove the cable-piercing screws from the replacement distributor block to avoid any possibility of the high tension cables not being fully seated in the base of the cable holes.

Apply powdered mica or talc to the cable surfaces which enter the distributor block holes, to prevent fusing to the walls of the holes.

A copper ferrule is secured over the end of the ignition cable which is inserted in the block. The cable conductor strands have been folded back under the ferrule to make good contact, and each ferrule has been stamped with its distributor block number. Insert each spark plug ignition cable in the distributor block hole corresponding to the number stamped on its ferrule. The ferrule and distributor block numbers denote the serial firing order of the magneto and not the cylinder numbers. For instance, the ignition cable inserted in the No. 2 distributor block hole goes to cylinder No. 10 which is the second cylinder to fire. Make sure the cables bottom in their holes and screw the cable-piercing screws tightly to insure security and proper contact. No lock washers are employed under the heads of the cable-piercing screws.

If a booster coil cable is employed, insert its end into the distributor block cable hole marked "B." Secure it with a cable-piercing screw having no lock washer under its head.

Before installing the radio shields, it is recommended that the connections be checked for any shorted or open circuits and to ascertain whether or not the cables lead to the proper cylinders from the magneto. To test for an open circuit in a cable and check the firing order of the cylinders, either a buzzer or light system is used. Touch the distributor block electrode with one point and the spark plug end of the cable for the proper cylinder, as designated by the engine firing order, with the other point. The circuit is complete when the buzzer gives a signal or the lamp lights. If the circuit is not complete, check for possible open circuit or wrong connection of the cable. The following table gives the relation between the cylinder and magneto firing orders:

<u>Magneto Distributor Block Number</u>	<u>Cylinder Number</u>
1 -----	1
2 -----	10
3 -----	5
4 -----	14
5 -----	9
6 -----	4
7 -----	13
8 -----	8
9 -----	3
10 -----	12
11 -----	7
12 -----	2
13 -----	11
14 -----	6

To test for a short circuit due to faulty insulation of the cable, a booster coil or magneto is used. Connect the high tension terminal of the booster to a distributor block electrode and hold the spark plug end of the corresponding ignition cable about 3/8 inch from a suitable ground. If a good spark does not jump this gap, examine the cable for faulty insulation.

Install the two radio shield halves on the distributor block allowing enough slack in the cables to prevent extremely sharp bends. Dowel pins in the radio shield parting surfaces insure correct alignment which is maintained by the two clamping bolts through the rear parting flanges. A lock washer is required under the nut of each clamp bolt. Inspect the two hex-head cap screws retained in the base of the shield for lock washers and screw tightly into the distributor block. Attach the ignition cable radio shielding adapter to the front of the distributor shield at its outlet, using two drilled hex-head cap screws with a lock washer under the head of each. Safety wire the cap screws.

Install the shielded distributor block and the coil cover on the magneto in accordance with the previous instructions.

g. Magneto Ground Terminal Removal.- Swing the spring wire lock ring out of the slotted and knurled terminal retaining nut on the magneto coil cover and remove the retaining nut. The

shielded ground wire and terminal assembly may then be withdrawn. Unscrew the knurled contact button from the drilled terminal screw through which the ground wire is inserted with its strands spread over the threaded end. Straighten the ground wire strands and pull the terminal screw and rubber grommet from the wire.

h. Magneto Ground Terminal Installation.- With the ground wire cable enclosed in its radio shielding, it may be attached to the magneto coil cover as follows:

(1) Strip the end of the ground wire cable for a suitable length and twist the strands slightly so that they will enter the terminal screw readily. Slip the rubber grommet over the cable with the tapered end facing the magneto. This is used to affect a proper seat with the ground terminal screw bushing in the magneto coil cover.

(2) Insert the stripped end of the ground cable in the hole of the terminal screw, and fan the strands of the wire over the threaded end. Screw the knurled contact button on the threads of the terminal screw, thus securing and making proper contact with the strands of the ground wire.

(3) Insert the terminal and attached ground wire cable into the receiving bushing in the magneto coil cover. Tighten the knurled and slotted terminal retaining nut at the end of the ground cable radio shielding to the threaded receiving bushing, thus securing the ground terminal and shielding to the magneto coil cover. Snap the spring wire lock ring into the retaining nut slots.

i. Magneto Inspection and Maintenance.- At every 50-hour inspection period, inspect each magneto and maintain as noted below:

(1) Remove the breaker cover and clean the breaker housing.

(2) Examine the cam follower felt to see that it is properly lubricated. If oil appears on its surface when the felt is squeezed with the fingers, do not add oil. However, if the felt is dry, moisten it with Specification No. AN-VV-O-446 oil, grade 1100 or 1120, (engine oil). Do not apply too much oil since the excess will be thrown off during operation and will foul the contact points thereby causing pitting and burning. Always keep the breaker compartment clean and free from excess oil.

(3) Inspect the magnetos for:

Damaged cam followers.

Damaged breaker felts or cushions.

Weak or broken breaker arm springs; use scale to check tension.

Worn or loose cams or bearings.

Excessive lubrication; but lubricate if necessary as noted above.

Cleanliness.

Security of mounting.

(4) Replace breaker assembly if necessary.

(5) See that safety wire or pins are installed where necessary.

(6) Inspect distributor for:

Cracked head or rotor.

Sticking or broken brush.

Signs of arcing.

Mounting screws for tightness (use screwdriver).

Replace head, brush, or rotor, if required.

(7) Inspect breaker contacts and check the adjustment as described in part (2) c. of this section.

3. Ignition Cable and Conduit.

a. Shielded Ignition Cable Removal.- Disconnect the shielded ignition cable terminal from the spark plugs of all cylinders.

Remove all spark plug conduit attaching clips from the push rod housings of the front row cylinders, leaving the clips on the conduits with their clamp screw and nuts temporarily re-installed.

Remove the clip attaching screws and nuts securing the rear spark plug conduits of all the cylinders to the brackets on the intake rocker boxes of the front row cylinders. Leave the clips and temporarily re-installed screws and nuts on the conduits. Do not remove the brackets which hold the spark plug conduits away from the cylinder head fins.

Loosen the main radio shielded conduits from their crankcase brackets by removing the lock wire, screws, and washers securing the upper halves of the brackets to the lower halves.

Remove the radio shielded distributor block from each magneto, disassemble, and withdraw all ignition wires according to instructions in part e. (2) of this section. Unscrew the knurled couplings and slide the adapter from the rear end of each of the main ignition conduits.

Withdraw the rear spark plug conduits from the spark plug cooling air ducts in the cylinder head air deflectors, being careful not to damage the terminal contacts.

Remove the cylinder barrel air deflectors from cylinders No. 3, 4, 12, and 13, following the instructions outlined in section XIII.

Remove the four nuts and palnuts securing the ignition manifold ring to the nose section of the engine. Loosen the knurled coupling holding the jointed manifold ring together, the couplings attaching the large flexible conduits to the manifold, and remove all controls and lines which hamper its removal. Withdraw the shielded ignition cable assembly forward from the engine in the most convenient manner permitted by the installation.

b. Shielded Ignition Cable Installation.- Prepare the replacement radio shielded ignition cable assembly for installation by removing its distributor blocks according to instructions in part e. (2) of this section. Unscrew the knurled couplings and remove the adapter from the rear end of each large flexible conduit, being careful not to lose the gasket on the adapter. Loosen the knurled coupling attaching the two halves of the jointed manifold ring together.

Place the assembly in position on the engine, passing the large flexible conduit for the left hand magneto between No. 12 and No. 13 cylinders and the conduit for the right hand magneto between No. 3 and No. 4 cylinders. Place the four drilled lugs projecting from the inside diameter of the manifold ring over the proper nose section studs, and re-install the nuts and palnuts which were removed with the replaced shielding assembly. Tighten the knurled couplings securing the halves of the manifold ring together and those securing the main conduits to the manifold ring, having the gasket properly seated between each joint.

Install the magneto outlet adapter with gasket on the rear end of each large flexible conduit. Powdered mica or talc on the ignition cables will aid in their installation. Leave the knurled couplings loose enough to permit adjusting the position of the adapters. Connect the magneto distributor blocks and radio shielding to the ignition cables and install in each magneto following the instructions in part f. of this section.

Place the large flexible conduits in the lower half of their crankcase brackets which are bolted to the crankcase between cylinders No. 12-13 and No. 3-4. Install the upper halves of the brackets and secure with screws, washers, and lock wire. The protective sections of sleeve

on each main conduit should be spaced between the attaching brackets so that the clamps grip the braided shielding and not the sleeve. Tighten the knurled couplings at the main conduit outlet adapters.

Work all of the small flexible conduits leading to the rear spark plugs through the air ducts in the cylinder head air deflectors, being careful not to damage the spark plug terminal contacts.

Attach the clips of the rear spark plug conduits of cylinders No. 2, 4, 6, 8, 10, 12, and 14 to the steel bracket on their intake rocker boxes with screws and elastic stop nuts. Make sure that the spark plug terminals are accessible to their respective spark plugs and that the protective sleeve is between the conduit clip and the spark plug terminal.

Install the clips of the rear spark plug conduits of cylinders No. 1, 3, 5, 7, 9, 11, 13 over the studs in the outer side of the front row cylinder intake rocker boxes, and retain with nuts and palnuts. Make sure the spark plug terminals are accessible to their mating spark plugs and that the protective sleeve is between the conduit clip and the spark plug terminal.

Install the clips attaching the ignition cables to the push rod housings.

Install the cylinder barrel air deflectors on cylinders No. 3, 4, 12, and 13, following the instructions outlined in T. O. No. 02-35HB-2.

Connect the shielded ignition cable terminals to all of the spark plugs, making readjustments to conduit attaching clips where necessary for accessibility.

c. Spark Plug Shielded Terminal Replacement.- Each ignition cable makes a positive connection to a shielded spark plug by means of a spring which is insulated by a sleeve of formica material. This insulated spring contact is retained in the threaded receiving chamber of the spark plug by a hex coupling seating on the shoulder of a brass elbow which is attached to the end of each spark plug conduit.

If the attaching coupling threads become worn or the contact insulation is defective, the shielded terminal assembly may be replaced as follows:

(1) Straighten out the ignition cable strands which are fanned out around the base of the coiled contact spring and pull the spring and sleeve assembly from the end of the cable.

(2) Loosen the knurled coupling securing the terminal elbow to the cable shielding and withdraw the elbow and rubber gland.

(3) If the ignition cable is of insufficient length for additional stripping of insulation, loosen the knurled coupling where the spark plug conduit joins the manifold ring and slide back the braided conduit enough to make the cable accessible. The required slack may be obtained by drawing up on the cable at this point and re-installing the shielded conduit.

(4) Make sure the contact spring and washer assembly is not loose in the formica sleeve by inserting a 1/4-inch diameter rod in the sleeve, bottoming on the fingers, and press down with a twelve to thirteen pound load. Repeat this procedure with the sleeve inverted on the rod. If the contact washer moves in either direction, the sleeve assembly should be rejected.

(5) Install the replacement shielded terminal elbow on the end of the spark plug conduit, having a new rubber gland in the joint between the two. Twist the strands of the ignition cable slightly to enter the terminal contact readily and insert the cable into the formica sleeve with its stripped end extending through the hole at the base of the contact spring. Trim the ends of the cable strands and fan them out against the base of the spring. No solder is necessary. Press the wire strands securely into position over the end of the contact washer nipple by means of a small copper tube (1/8 inch I D).

d. Spark Plug Shielded Conduit Replacement.- Replacing any individual ignition cable in a radio shielded cable assembly is not recommended, but any defective shielded spark plug conduit may be replaced easily as follows:

(1) Remove the spark plug terminal elbow and contact according to instructions in part c. of this section.

(2) Loosen the knurled coupling attaching the spark plug shielded conduit to the manifold ring and slide the conduit and rubber grommet off the ignition cable.

(3) Slip a new rubber grommet over the ignition wire with its tapered end seating in the manifold ring. Slide the replacement flexible shielded conduit over the spark plug ignition cable.

Make sure ample cable is provided to attach the spark plug shielded terminal, and tighten the knurled coupling on the manifold ring.

(4) Install the spark plug shielded terminal elbow and contact on the end of the ignition cable according to the instructions in part 3 (c) of this section.

4. Booster Coil.

a. The operation of the booster coil is automatic. When the starter switch on the main switch box is thrown to the "MESH" position, the primary circuit of the coil is connected with the battery, the primary coil magnetizes the soft iron core causing it to attract the vibrating contact and open the primary circuit. The core immediately demagnetizes and allows the contacts to close. This "make and break" in the primary circuit continues as long as the starter switch is in the "MESH" position. During the portion of the cycle when the contacts are open, the condenser, connected across the contacts and primary coil, forms a resonant circuit which induces a high voltage in the output or secondary coil circuit.

b. Maintenance.- When properly installed and operated, the booster coil should not require any attention between major overhaul periods. In the event that trouble is experienced during normal operation, replace the unit and send the unserviceable coil to the depot for overhaul.

5. Spark Plugs.

a. Types.- The following types of spark plugs may be used on the Wright Model R-2600-8 engine.

Aero - - - - -	LS38C
Bendix - - - - -	5S7
B. G. - - - - -	LS465
Champion - - - - -	C34S
A. C. - - - - -	LS85

Solid copper gaskets having a thickness of between .068 and .095 inches must be used when installing the spark plugs. Install one gasket under each spark plug except where the cylinder head thermocouple is installed. When installing or removing spark plugs, use only the special wrench provided for this purpose. Apply 450 to 500 inch-pounds torque to tighten plugs in cold engine. Attach the spark plug terminals so that any motion of the ignition wire assembly will tend to tighten rather than to loosen the spark plug. Slide or snap the spark plug shields in place and lock the fasteners on each shield so that they are secured firmly to the cylinder head air deflectors.

b. Use and Proper Care.-

(1) Ignition difficulties that are actually failures of some other part of the system, such as the magneto, shielding, carburetor, etc., are frequently blamed on the spark plugs, and will be fully investigated prior to definitely concluding that the plugs are at fault. Visual inspection upon removal of plugs may indicate any of the following conditions, but caution should be exercised in drawing conclusions; since visual checks are sometimes misleading:

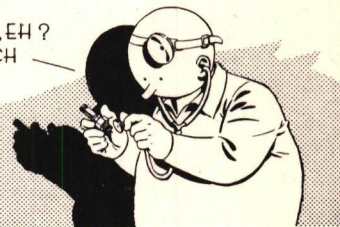
(a) If the plug is clean and the metal shows signs of over-heating, the cylinder has been running too hot, indicating preignition, detonation, or poor cooling.

(b) If the plug is generally clean but is wet with gasoline or covered with a film of fresh oil, no conclusions should be drawn on this basis alone, since the appearance of the plug may be due to conditions which were present at the moment of stopping only.

(c) The presence of caked carbon is evidence of the beginning of excessive oil consumption, or that the plug has not been firing due to magneto, terminal, or wire defects, or to failure of the plug to clean up after starting.

(d) A thin layer of black soot on the nose of the insulator, which otherwise looks quite free from deposits, may be sufficient to short circuit the plug. This may be an indication of insufficiently high plug operating temperatures. Plugs which do not operate at sufficient temperature should be reported with a view to a possible change in the type plugs approved for the engine in question.

BURNED ELECTRODE, EH?
BEEN DOING TOO MUCH
SPARKING... I GUESS



(e) In the case of shielded plugs, the following conditions may occur in addition to the foregoing:

1. Terminal failure (insulation).
2. Condensation of moisture in terminal.
3. Mechanical failure of terminal.

(2) It is important that the following instructions be observed when handling and servicing the plugs.

(a) Use only spark plugs of the types recommended for the particular engine.

(b) Always use the proper tools when removing, disassembling, assembling, or installing plugs. Under no circumstances will chisels, punches, oversize wrenches, etc., be used for this purpose. Furthermore, wrenches will be applied only to the shell hex when installing or removing plugs. Twelve-point or box wrenches not over ten inches in length are preferred, and, if not already on hand, will be obtained by requisition.

(c) Do not apply too much pressure to the wrench when assembling or installing spark plugs as the plug bodies may be stressed to a point that will result in distortion of the gasket seat between the core and the shell. This accounts chiefly for the tendency of cores to become loose. Care must also be exercised when installing or removing spark plugs to prevent the wrench from tilting to one side, or slipping and striking the head of the plug. In the case of shielded spark plugs, improper use of wrenches may damage the mica or ceramic insulated sleeves and threads.

(d) If plugs become loose at the joint between shell and core, they will be removed for tightening. When tightened, the gap clearance will then be checked, as rotation of the core will change the gap.

(e) Always determine that the spark plug cylinder copper gaskets are free from deep ridges or nicks to insure leak-proof compression.

(f) Whenever checking the installation of shielded plugs, always check the terminals and elbows to see that they are securely tightened. Excessive tightening of the elbows will be avoided, since this may cause rotation of the core with respect to the shell, thus closing the electrode gaps. Elbow wrenches No. 42B1-5194-1 and No. 42B1-5194-2 will be used for tightening A-N type elbows (5/8-inch spark plug terminal thread).

(g) Plugs will never be thrown together as though they were scrap material, but will be kept in separate containers or trays with thread protectors installed. They are easily damaged by rough handling.

(h) The center electrodes will never be used as a pry to increase the clearance between shell and center electrodes. This throws the center electrode out of line, puts it under a strain, and the mica laminations become loose, or the ceramic insulator is cracked.

If the side electrodes of a ceramic plug are accidentally pushed too close to the center electrode at the time of regapping, the plugs will be regarded as serviceable if the gap clearance is not less than .008 inch. All ceramic spark plugs with a gap clearance of less than .008 inch will be returned to the control depot for subsequent return to the manufacturer. Under no conditions will an attempt be made to disassemble ceramic plugs for the purpose of correcting errors in adjusting the side electrode for any other reason.

c. Spark Gap.-

(1) The spark gap of all new aircraft plugs will be initially set at .012 inch + .002 inch - .001 inch by the manufacturer. Whenever the gap is found to exceed .020 inch, the electrodes on the ceramic-type plugs will be regapped; or, if a mica type, the plugs will be regapped and/or reconditioned as the case may require. Normally plugs will not be removed for the sole purpose of checking the gaps, even if it is considered likely that the gap exceeds .020 inch, except on airplanes which are operated at high altitudes. The gaps on plugs installed in these airplanes should be checked and reset every 25 hours pending availability of spark plugs with less electrode erosion. The maximum of .020 inch is applicable to plugs removed for routine inspection or for other reasons. When the gap is reset, it shall in all cases be adjusted to .012 inch + .002 - .001. An occasional plug with a gap setting as low as .008 inch will be satisfactory. This should not be construed to mean that a setting of less than .011 inch is desirable.

(2) Suitable diameter of hard steel wire will be used to measure the gap clearance as shown in fig. 2-XIV.

(3) Under no conditions should the side electrode be reset when a thickness gage is between this part and the center electrode. Such methods will invariably damage the core insulation and any plugs thus adjusted through error should be disposed of in accordance with paragraph 5.

d. Installation.-

(1) Care will be taken when removing the terminal end thread protector cap to determine that the rubber washer installed in some caps is not allowed to enter and remain in the terminal well. Reports have been received in which the rubber washer entered the terminal well and prevented a good connection between the spark plug lead and terminal, with resultant plug failure.

(2) When installing plugs in engines, a solid copper gasket, part No. 40A888-718-968-080, will be placed between the spark plug and the cylinder, (see paragraph 5. a.) except where a thermocouple gasket, part No. 35A2037, is used, in which case no other gasket is required. Gaskets will be replaced whenever they contain dents, nicks, etc., or whenever they become excessively flattened. Spark plugs will not be installed or tightened in hot engines, as thread seizure with subsequent damage to the spark plug shell and cylinder bushing may result.

(3) Lightly lubricate the threads of the plugs, using spark plug thread lubricant, Specification No. AN-VV-C-566; the lubricant should be thoroughly stirred prior to use. Care will be taken that only a light coating of lubricant is placed on the shell threads, and that no lubricant is placed on the cylinder bushing threads. Any lubricant which may have been deposited on the firing end of the plug will be completely removed before installation of the plug.

(4) Spark plugs will be drawn down firmly to prevent compression leakage, however, wrench pressures sufficient to distort the shell will be avoided. A torque of approximately 480

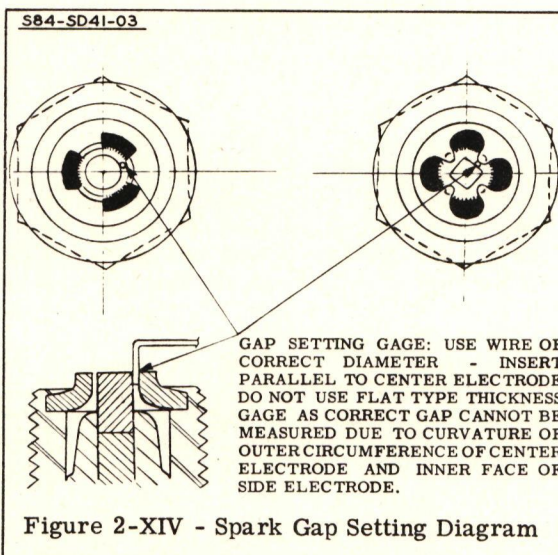


Figure 2-XIV - Spark Gap Setting Diagram

inch-pounds is sufficient and should not be exceeded. (Use wrench having a 10-inch leverage.) The mistaken idea that, unless a plug is screwed into the cylinder with high torque, the spark plug may become loose with service, is entirely erroneous. Careful checks indicate that the plugs tend to tighten in service due to corrosion of the threads and deterioration of the thread lubricant. Thus the above figure of 480 inch-pounds is actually a higher torque than is necessary for satisfactory operation.

(5) When installing the elbow assembly of shielded plugs on high tension cables, approximately 1/4 inches of the insulation will be removed from the end of the cable. The cable will then be inserted through the elbow at the thread end, through the Neoprene collars, and into the terminal end assembly, extending the bared end of the wire through the small hole in the sleeve washer. The collar will be installed with the shoulder next to the elbow. If a length of the bared wire in excess of that specified above is extended through the insulated sleeve washer in this manner, the terminal will not extend into the plug sufficiently to allow the full threaded depth of the elbow nut to be screwed onto the plug. If tightened with this condition existing, damage to the end assembly will result. When inserting the bared wire be sure that all the strands protrude through the hole in the washer, then securely flare over the strands. When installing BC type sleeves, care will be taken to prevent stretching of the terminal spring. When tightening elbow terminal and shielding nuts, care will be exercised that they are not tightened excessively, but only sufficiently for a snug fit, as the elbow terminal and plug may be damaged. It may also be found, when unscrewing tightly installed elbow nuts from spark plugs, that the barrel will tend to loosen and unscrew from the shell. If, while installing or removing elbow nuts or at any other time, the barrel is turned with respect to the shell, the plug should not be used until the gap is checked.

(6) All plugs will be inspected at the time of installation for evidence of damage to electrodes, threads, or terminals. Those which are damaged either on the electrodes, threads, or the entrance to the terminal well will be replaced.

e. Periodic Inspection and Replacements.-

(1) 25-Hours.- The gap clearance of spark plugs installed in airplanes which are operated at high altitude will be checked and reset to .012 inch + .002 inch - .001. A roughness at high altitude with relatively smooth operation at lower altitude indicates the need for regapping. Terminal connections of unshielded plugs and elbow terminal shielding nuts of shielded installations will be checked for security. When checking the elbow assembly of shielded plugs, extreme care must be exercised, to see that the barrel is not rotated with respect to the shell, since this will change the gap setting. The present common practice of slightly tightening the elbow nut at each 25-hour inspection will be discontinued. All AN type elbow (5/8-inch 24 terminal end thread for 3/4-inch hex) will be checked using elbow wrenches, tool Nos. 42B15194-1 and 42B15194-2. Under no conditions will the tightness of the elbow be determined by a twisting motion applied to the body of the elbow.

(2) 100-Hours.-

(a) All spark plugs will be removed at 100-hour intervals (each second 50-hour inspection) and replaced with new or reconditioned plugs of an approved type. In case it becomes necessary to replace spark plugs prior to the 100-hour inspection, the operation time since the plugs were installed will be obtained from AAF Form 41, for the particular engine in question, and this operating time furnished whenever unsatisfactory reports are submitted.

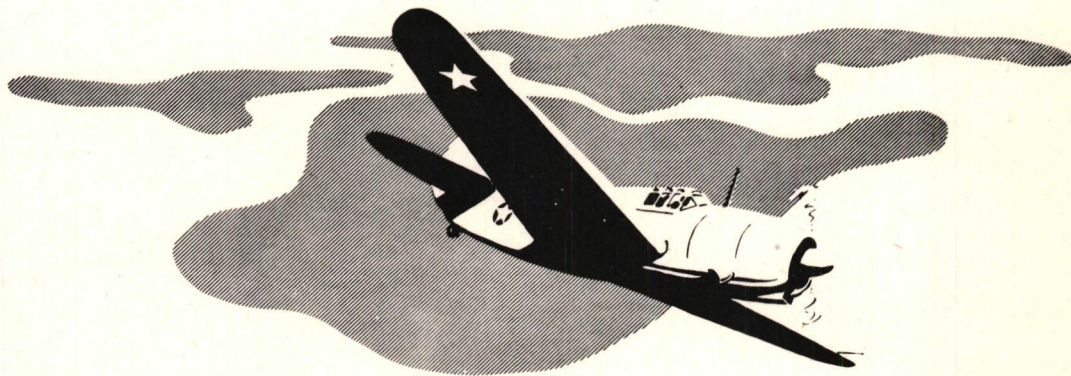
(b) In emergency or field operation wherein complete spark plugs servicing equipment is not available, regapping of ceramic plugs will usually be sufficient. The ceramic type does not have the tendency toward lead fouling as does the mica plug, although all fouling may be encountered in engines of high consumption or after prolonged ground idling. The ceramic plug has a superior ability to clean itself in flight if the front and rear plugs are not both fouled in the same cylinder.

In the event starting difficulties are encountered, during cold weather operation, the spark plugs should be removed and inspected for the possibility of ice forming on the electrode of the plug. This condition is more likely to prevail with the plugs installed in the lower cylinders of radial engines.

f. TROUBLE SHOOTING - IGNITION SYSTEM.

- (1) Failure of both magnetos. (a) Moisture in radio shielding harness. Faulty insulation on ignition wire. 1. Remove wire and dry harness in oven or with blow torch. If oven is used, do not exceed 71 degrees C (160 degrees F). If torch is used, do not concentrate flame. Play flame rapidly over surface of harness until it is hot to touch. This will approximate above temperature. Carefully check entire wiring harness and change if necessary.
- (b) Terminals or wires connecting both primary windings to the switch grounded or shorted. 2. Disconnect wires at back of switch. If engine will start, trouble is in the switch. If not, trouble is in wires to magnetos.
- (c) Breaker assemblies defective or shorted. Usually from rain or snow. (Do not leave engine or accessories uncovered when cowl is off.)
- (2) Trouble in one magneto. (a) Defective breaker assembly. 1. Check for weak, set, or broken spring. Spring tension must exceed 15 ounces of pull on scale. (If new spring is installed, tension must be 20 to 32 ounces.) Check for oil on points, pitted points, burned points. (If the points are burned, the condenser is probably faulty.)
- (b) Ground wire chafed and in contact with ground. 2. Replace wire.
- (c) Booster coil not functioning. 3. Check vibrator points. Check terminals and wire leading to starter switch. Check high tension wire to magneto. NOTE: Disconnect cannon plug from starter before testing booster coil as meshing of the starter is not desired during booster coil test.
- (3) Trouble in one magneto. (a) Broken drive. 1. Remove magneto and check drive carefully. Account for every particle of broken material. If there is any doubt, the engine will have to be removed and dismantled to remove foreign objects.
- (b) Defective coil. 2. Replace coil. If no coil is available, replace magneto. Coil is not repairable.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
	(c) Defective condenser.	<u>3.</u> Replace condenser. If no condenser is available, replace magneto. Condenser is not reparable.
(4) Failure of spark plug.	(a) Plug too hot for operating conditions (preignition).	<u>1.</u> Install proper plugs for operating conditions.
	(b) Plug too cold (fouling).	<u>2.</u> Treat as above.
	(c) Insulator shorted.	<u>3.</u> Too long idling periods. Fouled by oil. Hold idling periods to reasonable length of time and engine to proper head temperature.
	(d) Points shorted with oil or carbon.	<u>4.</u> Clean plugs.
	(e) Dirt or foreign matter on outside of insulator.	<u>5.</u> Clean insulator.
	(f) Radio shielding coupling shorted.	<u>6.</u> Remove short.
(5) Failure of the engine to stop with the switch in the "OFF" position.	(a) Switch ground wire broken.	<u>1.</u> Install new ground wire.
	(b) Defective switch.	<u>2.</u> Change switch.
	(c) "IDLE CUT-OFF" not functioning.	



Section *XV*

CARBURETOR

1. Description.

a. General.- The Holley aircraft engine carburetor has a single air passage into which fuel is supplied from a single fuel supply chamber, the means of inducing the fuel into the air passage being the same as that employed by carburetors of other design, that is a controlled pressure differential which is produced by a reduction in the cross-sectional area of the air passage opening. This type of carburetor, however, is unlike those of other designs in that the supply chamber float mechanism is replaced by a diaphragm mechanism, and the control of the air passage is accomplished by means of a variable venturi rather than by the conventional butterfly valve and fixed venturi.

The fuel discharge nozzle and venturi throttles are arranged in such a way that the carburetor is inherently free of ordinary icing troubles. Also the type of fuel metering system and throttle used in this carburetor provides partial compensation for changes in altitude. However, in order to obtain more exact altitude adjustment and increased economy under favorable operating conditions, a manual mixture control is provided for leaning out the fuel-air ratio.

Throughout the remainder of this section, the side of the carburetor on which the data plate and the throttle and mixture control levers are located will be referred to as the rear "side." The "right" and "left" sides of the carburetor will be referred to as when looking from the rear toward the front. Fig. 5-XV is a detail assembly of the carburetor.

b. Main Body.- The main body of the carburetor consists of two end blocks bolted between two side plates. The two throttles, the metering channel, the discharge nozzle, and the throttle shaft are assembled with the main body. The throttles are made in the form of modified cylindrical sectors, having the discharge nozzle located between them and forming a streamlined venturi-shaped passage for all degrees of opening. The throttles fit in the main body with a small end clearance and are sealed against leakage by means of spring-loaded brushes of a molded plastic material which bear lightly on the top of the cylindrical surface. A gear on each throttle and on the throttle lever shaft serves to drive them in synchronism. The throttles are mounted on roller bearings and the throttle shaft on ball bearings.

The main diaphragm mechanism is fastened to the left side of the carburetor as a unit by means of nine studs and can be removed and replaced without disturbing other parts of the carburetor. The mixture control valve is self-contained in a small casting fastened to the rear face of the carburetor and may also be removed intact.

The carburetor is vented through a hollow rectangular casting which matches the air entrance and is provided with a number of small holes around the inside surface. This helps to obtain an average of the pressure existing at the entrance to the carburetor. Drilled passages lead from this vent ring to the space outside the two main fuel diaphragms.

c. Diaphragm Mechanism.- The diaphragm mechanism, which is located on the left side of the carburetor, consists of two similar diaphragms placed side by side, forming a fuel chamber between them. Each diaphragm is flexibly connected at its center to a lever, the other end of which bears on the end of a fuel valve. This valve is a ball-ended plunger sliding in a guide which also forms the seat. Fuel under pressure from the fuel pump enters through this valve and fills the chamber between the diaphragms. The weight of this fuel causes the diaphragms to bulge outwardly, thereby forcing the valves against their seats by means of the levers. When the fuel reaches a certain height in the chamber between the diaphragms, its weight exerts enough force on the diaphragms to close the fuel valves against the fuel pressure.

The outlet of the fuel chamber is at the top. Suction from the fuel discharge nozzle is carried back to this point and tends to draw the diaphragms together, which allows the fuel valves to open and admit more fuel. Thus at all times when the engine is running, the diaphragm chamber is entirely filled with fuel, which eliminates trouble arising from splashing and the re-

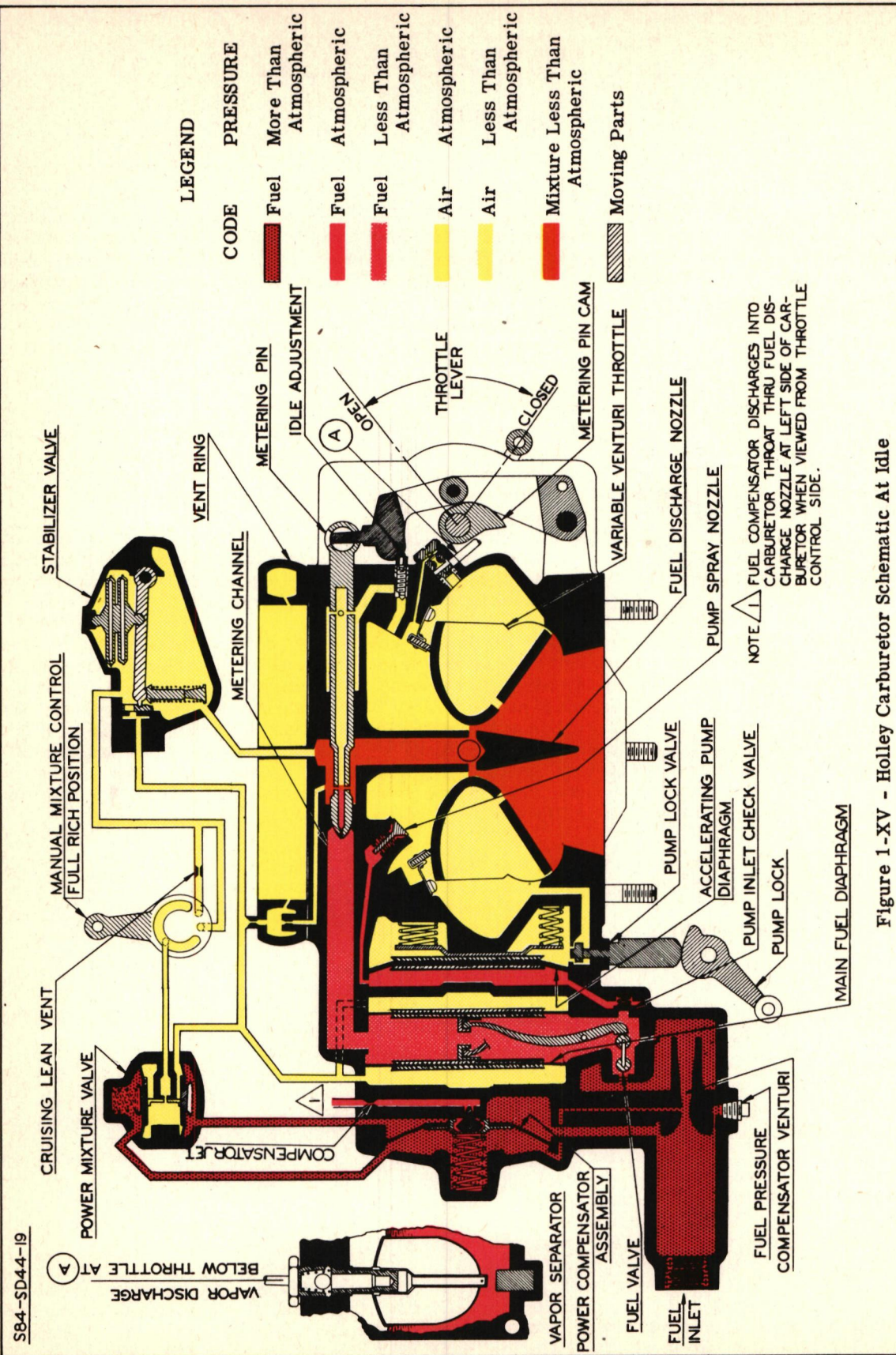


Figure 1-XV - Holley Carburetor Schematic At Idle

sulting interruption of fuel flow during violent maneuvers. By virtue of the symmetrical arrangement of the diaphragm section, the carburetor will function in inverted flight as well as right side up.

The method of regulating the fuel air ratio of the carburetor is as follows:

The main metering channel, which attaches to the outlet of the main diaphragm mechanism, is provided with a restriction and a tapered metering needle. This needle is actuated, through a cam lever, by a cam attached to the shaft which is geared to the bar above the throttles.

Thus, as the throttles are opened to increase the air passage, the fuel passage opening is correspondingly increased to provide the proper fuel flow. The cam profile is worked out to give an approximately constant mixture ratio for all throttle openings above the idling range. An air bleed is provided at the center of the main metering channel for the purpose of stabilizing the flow of fuel.

To obtain idle adjustment, an additional air bleed is used in the form of an adjustable valve. This valve is operative only when the throttles are nearly closed (engine idling), since it bleeds air through a passage in the center of the metering needle which shuts off as soon as the needle is moved out of the seat about one-sixteenth inch. Thus the idle adjustment is not effective for engine speeds above approximately 1000 rpm.

The idle adjustment is located near the throttle cam shaft on the forward side of the carburetor.

d. Power Compensator. - To provide mixture enrichment as engine power output is increased toward its maximum, an automatic enriching device is built into the carburetor. A venturi is provided in the fuel inlet. When there is a flow of fuel through this venturi, the pressure at the throat is less than the pressure at the entrance. The greater the fuel flow through the venturi, the greater the difference in pressure between the entrance of the venturi and the throat. This difference in pressure is used to operate a spring-loaded needle valve. When the fuel flow is increased to the point where the venturi differential pressure equals the initial tension on the spring, the needle valve starts to open. Further increase in the flow through the venturi increases the needle lift. This valve supplies an additional quantity of fuel directly from the fuel entrance to the compensator discharge nozzle, through the external tube located on the rear side of the carburetor.

Thus, while the diaphragm mechanism and main metering system supply the engine with a mixture of approximately constant "basic" or normal cruising strength, the compensator supplies automatically the additional fuel required to give the richer mixture desired at higher power outputs. There is no mechanical connection between the power compensator and the throttle mechanism. The operation of the power compensator and the amount that it enriches the mixture is governed by the amount of fuel that the engine is receiving through the main metering system, depending upon the horsepower output. Above a certain power output, the mixture is automatically enriched regardless of the throttle opening or altitude. Below this power output, the mixture remains at the normal value for cruising power, also regardless of throttle opening.

The tapered needle is attached to a flexible diaphragm, and is held against its seat by a spring. The chamber in which the needle and seat are located is connected to the fuel supply ahead of the venturi entrance. The other side of the diaphragm is connected to the throat of the compensator venturi. The spring is adjusted so that the compensator starts to operate at the specified fuel flow, and the greater the fuel flow beyond this point of opening, the greater will be the opening of the needle.

The power compensator is calibrated to provide the proper amount of fuel with six pounds per square inch to seven pounds per square inch pressure at the carburetor. This pressure must therefore be maintained, especially at high power output when the compensator is operating. A change in pressure of one pound per square inch will produce about two percent change in mixture when the compensator is operating. At low outputs, when the compensator is not operating, the mixture is not affected by changes in fuel pressure.

e. Accelerating Pump. - To insure rapid and positive acceleration of the engine, it is neces-

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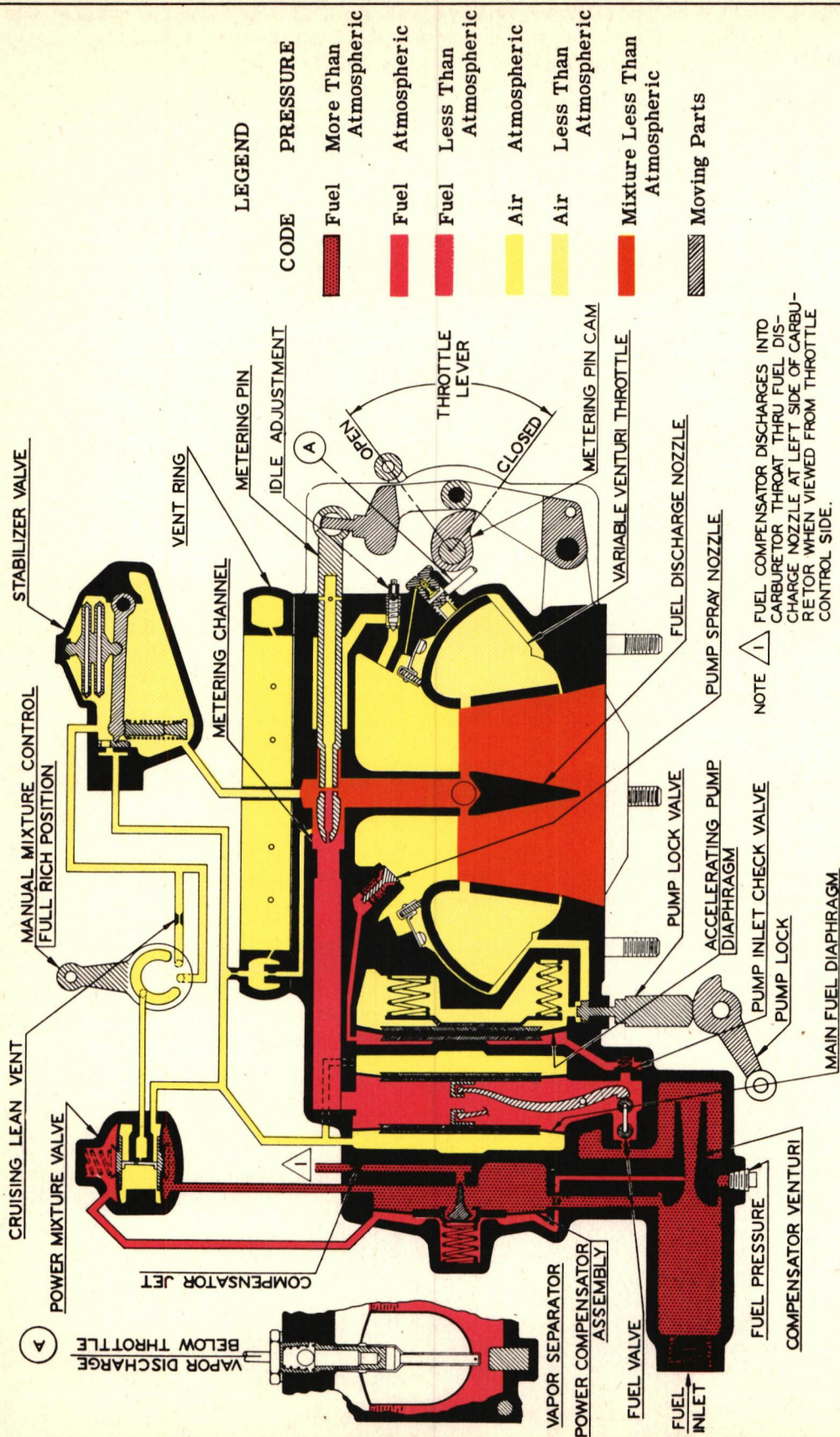


Figure 2-XV - Holley Carburetor Schematic At Take-Off

sary to provide an additional quantity of fuel when the throttles are quickly opened. For this purpose, a vacuum-operated diaphragm-type of accelerating pump is provided. This is located between the main diaphragm mechanism and the body of the carburetor. The complete pump mechanism consists of an inlet check valve and outlet spray nozzle, a diaphragm, three springs for moving it, and the pump lock valve. One side of the diaphragm is open to the vacuum that exists below the carburetor, when the throttles are closed and the engine running, and the other side forms a gasoline chamber with the inner wall of the main diaphragm mechanism. The springs are on the vacuum side of the diaphragm and tend to apply pressure on the fuel on the other side of the diaphragm. The inlet check valve is located in the bottom of the main diaphragm fuel chamber, and the outlet spray nozzle, which directs the accelerating charge down into the air passage of the carburetor, is located under the metering channel. The accelerating pump lock valve is in the passage leading to the vacuum side of the diaphragm and is closed when the mixture control lever is moved to the "FUEL CUT-OFF" position. This valve prevents the pump from operating when the engine is being stopped.

When the engine is idling, the high vacuum below the throttles pulls the pump diaphragm against the springs and draws a charge of fuel into the pump chamber through the inlet check valve. When the throttles are opened, this vacuum is broken and the springs compress the fuel in the pump chamber and discharge it through the spray nozzle. The action of the pump is automatic, there being no mechanical linkage between the pump and the throttles. This type of carburetor therefore cannot be used to prime the engine by opening and closing the throttles when the engine is not running.

f. Mixture Control.- It is characteristic of the design of this carburetor, with its particular combination of diaphragm mechanism, metering system, and venturi throttle mechanism, to compensate partially for altitude without the use of any auxiliary mixture control device.

A manual mixture control, however, is provided to permit leaning out to obtain more exact altitude adjustment and improved economy when cruising.

The actual effect of the mixture control valve is to apply to the air space outside of the main diaphragms a percentage of the same suction that exists at the metering needle. This reduces the suction available for drawing fuel out of the diaphragm chamber and results in a decreased pressure drop across the fuel metering restriction, which gives a decreased fuel flow and a resulting leaner mixture.

The amount of suction is regulated by varying the area of the mixture control valve passage, which admits the suction to the air space outside of the diaphragms. In the full "RICH" position, this passage is completely closed. As the control is moved toward the "CRUISING LEAN" position, a small slot on the mixture control disc is gradually opened. The amount of suction is further controlled by a restriction in the passage connecting the space outside the diaphragms to the vent ring (mentioned under "Main Body" above). This restriction bleeds off a portion of the suction and its size is selected so that, with the mixture control in "CRUISING LEAN" position, the mixture strength throughout the cruising range will not be less than the allowable minimum. Movement of the mixture control lever leans out the mixture over the entire range of operation from idle to full throttle.

A further function of the mixture control is to shut off the flow of fuel, preventing the engine from after-firing when it is stopped. This is accomplished by moving the mixture control through its full travel beyond the "CRUISING LEAN" position to "FUEL CUT-OFF" position. This exposes the outside of the diaphragm to practically the same suction as exists at the fuel metering restriction and, at the same time, locks the accelerating pump. With the suction thus balanced, the diaphragms act to close the fuel inlet valves and hence all fuel supply is cut off.

g. Stabilizer Valve.- Referring to the schematic fig. 5-XV, it will be noted that the stabilizer consists of a slide valve operated through a lever by the movement of sealed capsules which are filled with air at substantially atmospheric pressure and temperature. These capsules expand and contract for variations in pressure and temperature and thereby cause movement of the slide valve which acts to regulate the mixture ratio. The slide valve is connected in parallel with the manual mixture control valve and functions in the same manner, that is, by controlling the pressure behind the main fuel diaphragms. The preceding discussion on mixture control explains this in greater detail. The stabilizer, therefore, functions in effect as a self-operating mixture control valve which responds to variations in altitude, temperature, and engine load.

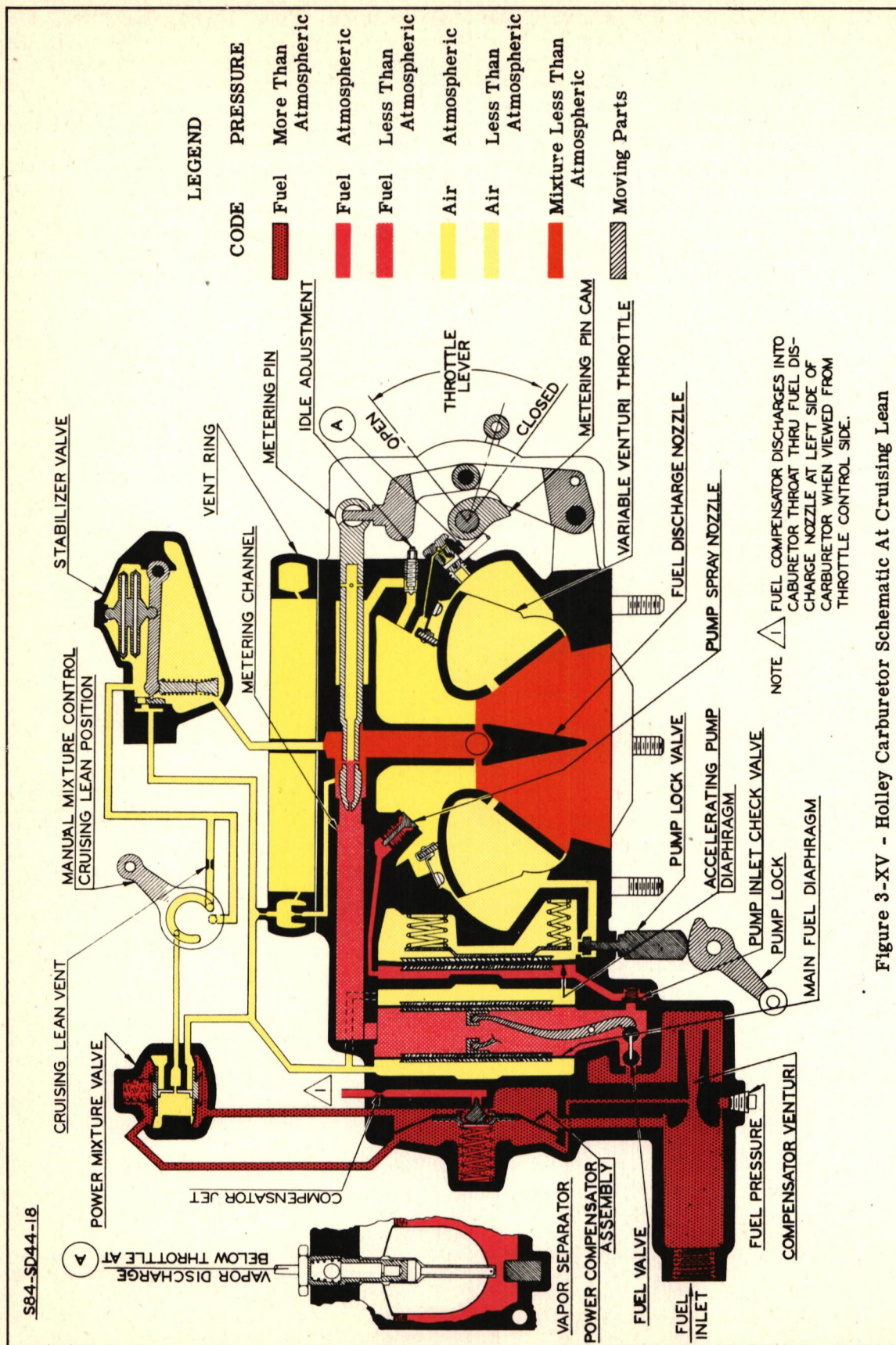


Figure 3-XV - Holley Carburetor Schematic At Cruising Lean

The stabilizer is in operation at all times, both in full "RICH" (or "AUTOMATIC RICH") and "CRUISING LEAN" (or "AUTOMATIC LEAN") positions of the manual mixture control. The stabilizer chamber is connected to the discharge nozzle and, therefore, responds to any conditions which affect the nozzle suction and hence the flow of fuel.

h. Vapor Separator. - Aircraft gasolines tend to release vapor and entrained air in normal flight operation due to several conditions, among which are the reduction in atmospheric pressure which occurs at altitude; the agitation and turbulence caused by the fuel pump, fuel pump relief valve, and elbows in the fuel line; and vaporization caused by any temperature rise which may take place in the fuel system. Along with this, the agitation of the gasoline flowing through the fuel inlet valves of the carburetor itself, causes an additional liberation of vapor. The vapor is objectionable in that it affects the metering characteristics of the carburetor if allowed to pass through the metering orifice. It is therefore important that this vapor be removed before the gasoline is metered in the carburetor. In the model "HA" carburetor, this is accomplished by the addition of a float-operated valve placed within the diaphragm chamber of the carburetor. The diaphragm chamber has been modified to move the fuel inlet valves to the top so that any vapor which is liberated at this point will have easy access to the vapor separator. The fuel is withdrawn from the diaphragm chamber at a point close to the center of the diaphragms, which assures that only the vapor-free gasoline will go through the metering orifice. Any accumulation of vapor in the upper part of the diaphragm chamber causes the vapor separator float to descend and open the vapor separator valve, thereby connecting the diaphragm chamber to the region below the throttles, which is always at a higher suction than the diaphragm chamber. The vapor is therefore withdrawn and the level in the diaphragm chamber will then rise and cause the vapor separator float to rise with it and shut off the vapor separator valve. The action of the vapor separator float does not interfere with the normal action of the main fuel diaphragms. The main fuel diaphragms respond to the head or pressure of fuel against them; whereas the vapor separator float responds only to the level of gasoline within the diaphragm chamber as determined by the relative volume of vapor and gasoline present.

i. Power Mixture Valve. - The schematic, fig. 5-XV, shows the connections of the power mixture valve in relation the other parts of the carburetor.

This valve overrides the action of the manual mixture control valve, and automatically restores the full rich mixture whenever the engine reaches a predetermined percentage of rated power, as indicated by the rate of fuel flow through the compensator venturi. The power mixture valve is in series with the manual mixture control valve and functions by closing the manual control valve passage. This occurs when the rate of fuel flow through the compensator venturi, for which the valve was adjusted, is exceeded, which would happen when a certain power output was being exceeded.

The timing and operation of the power mixture valve are controlled in identically the same manner as the compensator valve, previously described. As long as the mixture control is left in the full "RICH" position, the power mixture valve has no effect. If the manual mixture control is moved to the "CRUISING LEAN" position and the pilot should attempt to use take-off power, for example, the power mixture valve will override the action of the manual mixture control and will provide normal full rich mixtures for take-off power. If, after this, the power is reduced to below the maximum permitted for cruising lean operation, the power mixture valve will return to its original position and restore the cruising lean mixtures existing before the excessive power was applied.

j. Priming System. -

(1) General. - The primer valve consists of a solenoid-operated needle valve which is built into the fuel inlet casting of the carburetor. The primer is operated by a momentary switch on the main switch box. Closing the primer circuit energizes the solenoid and magnetizes the soft steel core. This magnet draws the needle valve A-415 off its seat A-414, by passing fuel from the main fuel line through the primer to the engine priming system. The primer remains in action as long as the switch is held closed.

(2) Operation. - When the engine is being started, it is first primed by building up fuel pressure with the emergency fuel pump and closing the primer switch for approximately five seconds.

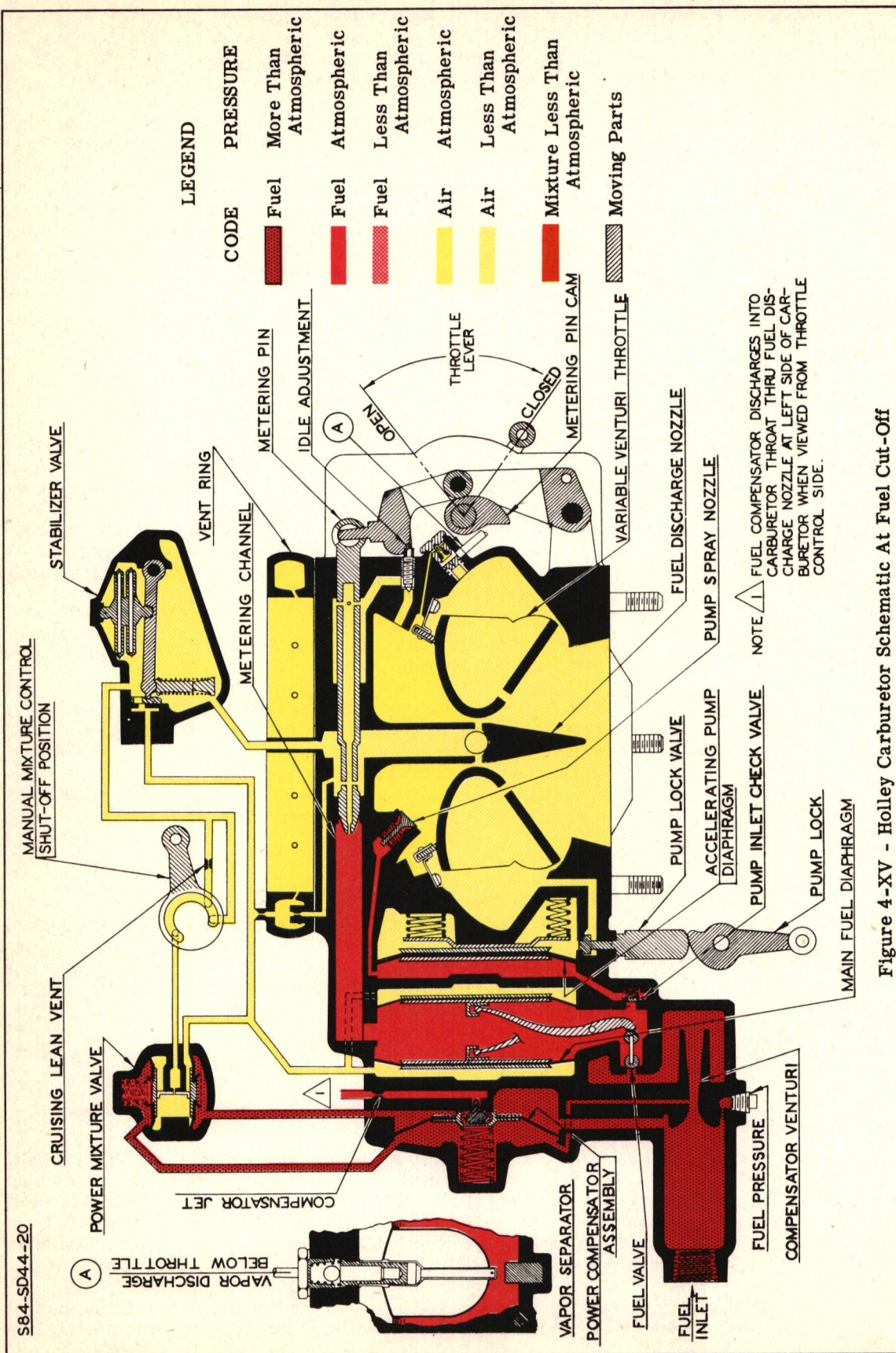


Figure 4-XV - Holley Carburetor Schematic At Fuel Cut-Off

The engine is then started, keeping the throttle in the nearly closed position; that is, where the engine will run about 800 rpm to 1000 rpm after it starts. As soon as the engine begins to run, fuel pressure will be maintained by the fuel pump and thereafter the primer may be operated by closing the switch for as long as necessary to keep the engine running smoothly while it is warming up.

The primer valve is an integral part of the carburetor and is overhauled with the carburetor at engine overhauls. Due to the simplicity and infrequent use of the primer, no maintenance should be required.

(3) Trouble Shooting. -

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(a) Engine will not start.	<u>1.</u> No fuel in carburetor.	<u>a.</u> Check by removing drain plug in diaphragm section.
CAUTION: Do not confuse this plug with accelerating check valve plug which has a 3/4-inch hex-head and is installed at an angle. The drain plug has a 9/16-inch hex-head, installed vertically.		
	<u>2.</u> Failure of metering needle operating mechanism	<u>b.</u> Check by removing cover from cam end (right hand) of carburetor and observing action as throttle is moved. Look for broken springs, sticking needle, or any disconnected parts.
	<u>3.</u> Failure of mixture control	<u>c.</u> Remove end cap from mixture control housing and inspect mixture control disc and its drive pin.
(b) Engine will not idle properly.	<u>1.</u> Idle adjustment not set correctly.	<u>a.</u> To check the idle mixture setting, locate the idle mixture lever at its mid-position (nine notches from full "RICH" position). Move the main mixture control lever to "CRUISING LEAN" stop and note the change in engine speed. An increase in speed indicates the mixture is too rich and idle mixture lever should be moved one notch leaner and the check repeated. If engine speed decreases, the idle mixture is too lean and the idle mixture lever should be moved one notch richer and test repeated. Idle setting is correct when there is a tendency for the speed to drop off slightly when the main mixture control is moved from the full "RICH" position to "CRUISING LEAN."

Some carburetors are equipped with a more sensitive adjustment (fig. 1-XV), which allows a closer idle adjustment, since

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
		an excess of 100 notches (as against 17 notches on the quadrant type) is used to cover the effective idle range. A spring-loaded ball detent on the knurled surface facilitates adjustment of the valve, holding it in any desired position.
	<u>2.</u> Air leaks between carburetor and engine.	<u>b.</u> Check for loose nuts and loose or missing plugs on carburetor or engine adapter
	<u>3.</u> Metering lever sticking or metering pin lever springs broken loose.	<u>c.</u> Remove cover from right-hand end and observe action as throttle is moved. Replace lever and/or spring.
	<u>4.</u> Compensator needle leaking.	<u>d.</u> Check by loosening two screws which attach the compensator fuel line fitting to the compensator unit casting, applying a pressure of six to ten pounds by means of the emergency fuel pump and watching for leak at the fitting flange. If a leak is observed, remove compensator diaphragm and inspect needle and seat.
(c) Engine runs too rich at cruising power.	<u>1.</u> Metering pin sticking or metering pin lever springs broken or loose.	<u>a.</u> See item 3 under "Engine will not idle properly" above.
	<u>2.</u> Metering pin and/or metering pin cam improperly adjusted.	<u>b.</u> If this condition is found to exist, return carburetor to depot for repair.
	<u>3.</u> Main air bleed clogged.	<u>c.</u> Remove scoop for access to top of carburetor. Remove air bleed cover screw, air bleed cover, and air bleed and inspect.
	<u>4.</u> Compensator needle leaking.	<u>d.</u> See item 4 under "Engine does not idle properly" above.
	<u>5.</u> Compensator valve spring weak or broken.	<u>e.</u> Remove compensator spring nut and remove spring, taking care not to lose any shims that may be in the recess in the nut. Inspect for breakage and compare size and stiffness of spring with one known to be correct.
	<u>6.</u> Diaphragm unit flooding.	<u>f.</u> Check by observing for continuous dripping of fuel from nozzles for more than one

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
		minute. Remove carburetor and return to repair depot if this condition exists.
(d) Engine runs too lean at cruising power.	<u>1.</u> Mixture control disc halves separated or drive pin sheared. <u>2.</u> Fuel pressure too low. <u>3.</u> Air leaking into carburetor fuel passages.	<u>a.</u> Remove end cap from mixture control housing and inspect. <u>b.</u> Adjust pressure to the six or seven pounds required for all-around operation. <u>c.</u> Check the following for tightness: (1) Attachment of metering channel to left-hand end block of diaphragm to main body. (2) Attachment of mixture control housing to main body. (3) Plugs in drilled passages in left end block and rear side plate. (4) 1/8-inch pipe plug on the mixture control housing. (5) Pipe plug on bottom of diaphragm section. (6) Main air bleed.
	<u>4.</u> Metering pin and/or metering pin cam improperly adjusted.	<u>d.</u> See item 2 under "Engine runs too rich at cruising power."
(e) Engine runs all right at cruising power, but is too rich at higher power. (Rated power or take-off.)	<u>1.</u> Fuel pressure too high. <u>2.</u> Main air bleed clogged. <u>3.</u> Air leak between vent ring and carburetor main body. <u>4.</u> Air leaking into diaphragm vent space. <u>5.</u> Diaphragm unit flooding. <u>6.</u> Compensator spring weak or broken.	<u>a.</u> Pressure will be adjusted to six or seven pounds. <u>b.</u> See item 3 under "Engine runs too rich at cruising power." <u>c.</u> With scoop removed, check for loose or missing attachment screws. <u>d.</u> Check tightness of attachment of mixture control housing to main body and of the diaphragm vent space drain plug. <u>e.</u> See item 6 under "Engine runs too rich at cruising power." <u>f.</u> See item 5 under "Engine runs too rich at cruising power."

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(f) Engine runs all right at cruising power, but is too lean at higher power.	<u>1.</u> Fuel pressure too low.	<u>a.</u> Check and adjust to six to seven pounds per square inch.
	<u>2.</u> Turbulent flow of air into carburetor.	<u>b.</u> Caused by loose backfire door on air scoop, air scoop out of alignment with carburetor, or improperly designed air scoop.
	<u>3.</u> Diaphragm vent and/or vent passages clogged.	<u>c.</u> Check by removing the 1/8-inch plug from the mixture control housing and unscrewing the diaphragm vent restriction which is accessible when this plug is removed. Inspect the orifice for clogging and clean as required. Remove the 1/8-inch drain plug from the bottom of the space outside the diaphragms and check the passages for clogging by blowing gently on a rubber tube applied to the drain opening. If the passages are obstructed, the diaphragms section must be removed and disassembled for cleaning.

CAUTION: Do not use compressed air to blow out these passages while carburetor is assembled.

	<u>4.</u> Compensator spring tension excessive.	<u>d.</u> See item 5 under "Engine runs too rich at cruising power."
	<u>5.</u> Broken compensator diaphragm.	<u>e.</u> Remove compensator cover and inspect.
	<u>6.</u> Compensator venturi not seated properly.	<u>f.</u> Remove fuel inlet for access and check venturi for tightness of seating. A convenient method of checking is first to close the throttle and then to blow gently through a rubber hose applied to the mouth of the venturi. If there is any fuel remaining around the edge of the gasket, imperfect seating will be evidenced by bubbles or disturbances of this liquid.
(g) Engine runs all right full "RICH" but is too rich or too lean in "CRUISING LEAN."	<u>1.</u> Diaphragm vent restriction clogged or of wrong size.	<u>a.</u> Remove 1/8-inch plug from mixture control housing for access to vent restriction. Unscrew and remove the restriction. If it is clogged or too small, the cruising lean mixture will be too lean. If

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
		the hole in the restriction is too large, the cruising lean mixtures will be too rich.
	<u>2.</u> Slot in mixture control disc clogged.	<u>b.</u> This will make mixture too rich. Check by removing end plate from mixture control housing and inspecting disc. Blow out with air, if clogged.
	<u>3.</u> Mixture control disc not seating properly.	<u>c.</u> This will make mixture too lean. Clean and blow out to remove any foreign matter. The working surface must have a dead smooth lapped finish to mate with a similar finish on the mixture control housing. If this condition does not exist, return the carburetor to a repair depot for correction.
	<u>4.</u> Passages in mixture control housing clogged.	<u>d.</u> Remove housing and check, with end cap installed.
<u>NOTE:</u> This will serve as a check on items 2 or 3 also.		
	<u>5.</u> Vent and/or suction passages in main body and diaphragm section clogged.	<u>e.</u> Remove the mixture control housing exposing the two openings to these passages on the mounting pad. Check the section passages by blowing on the upper hole. Remove the 1/8-inch drain plug from the bottom of the space outside the diaphragm and check the vent passages for leaks by replacing the drain plug and applying a gentle suction to the lower hole in the pad. The passage should hold the suction.
(h) Engine does not accelerate properly.	<u>1.</u> Engine does not idle properly.	<u>a.</u> For good acceleration, it is necessary that the engine first be adjusted to idle reasonably well. See idling instructions in foregoing.
	<u>2.</u> Mixture too lean in cruising range.	<u>b.</u> Engine will not accelerate properly to any given rpm if the mixture at that rpm is too lean for that operation. See section lean cruising mixtures.
	<u>3.</u> Accelerating pump check valve leaking or check valve spring broken.	<u>c.</u> Remove 3/4-inch hex-head plug in lower part of center section of diaphragm unit and inspect valve disc and its seat and spring.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
	<u>4.</u> Accelerating pump discharge nozzle leaking.	<u>d.</u> Remove scoop and inspect nozzle. Lift the pump nozzle valve with fingers and release. It should snap back on its seat. If not, the spring is probably broken. If any dirt is found, hold the valve open and flush with kerosene or gasoline, using an oil can. If found to be faulty, it will be preferable to remove carburetor to replace nozzle.
	<u>5.</u> Pump lock plunger stuck in "CUT-OFF" position.	<u>e.</u> Remove and free up as necessary.
	<u>6.</u> Pump diaphragm springs broken.	<u>f.</u> Remove carburetor and remove diaphragm. Inspect springs and replace if necessary.
(i) Engine does not shut off properly.	<u>1.</u> Mixture control disc parts separated or drive pin sheared.	<u>a.</u> Remove end cap from mixture control housing and inspect.
	<u>2.</u> Mixture control passages clogged.	<u>b.</u> Remove housing and check, with end cap installed.
	<u>3.</u> Pump lock plunger broken or not seating properly.	<u>c.</u> Remove the pump lock assembly and inspect for free movement of the plunger and condition of the leather washers.
	<u>4.</u> Pump lock cam not properly set on shaft.	<u>d.</u> The peak of the cam must be in line with the plunger when the mixture control lever is in the "FUEL CUT-OFF" position.
	<u>5.</u> Compensator valve leaking.	<u>e.</u> See item 4 under "Engine does not idle properly."

2. Removal and Installation of Carburetor.

a. Remove the carburetor air scoop assembly.

(1) Remove four screws from top side of bulkhead and lift off section, thus disconnected. This will allow scoop to be raised from its position after the following steps are performed.

(2) Disconnect cowl flap mechanism. Removing nuts from four studs and disconnecting tie-rod from air scoop door lever will allow complete disassembly of this mechanism from scoop.

(3) Disconnect carburetor air temperature connection on aft end of scoop.

(4) Disconnect door operating shaft at quick-disconnect near fire wall.

(5) Remove nuts from eight studs holding scoop to carburetor.

(6) The scoop may now be lifted from carburetor. When the scoop is away, lift screen

Trouble

Cause

Remedy

and gaskets from top side of carburetor. Close carburetor throttles to keep foreign matter out of passage way.

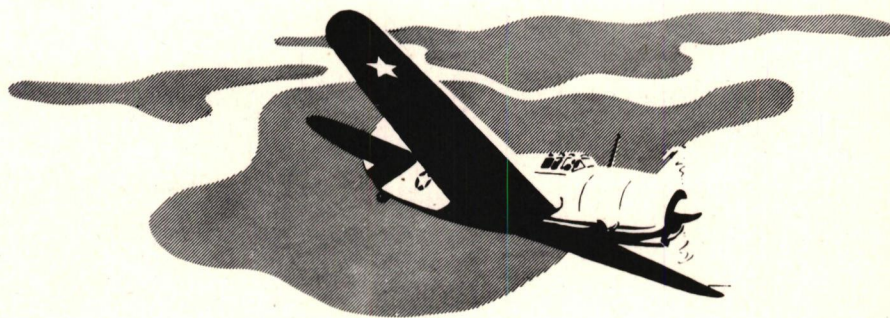
b. Removal of carburetor. -

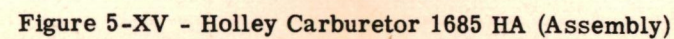
- (1) Disconnect throttle control.
- (2) Disconnect fuel mixture control.
- (3) Disconnect fuel pressure gage lines.
- (4) Disconnect three-way valve of three-point priming system.
- (5) Disconnect electrical connection of three-point primer.
- (6) Remove flexible fuel inlet line.
- (7) Remove six hold-down bolts from studs (carburetor to adapter).
- (8) Ascertain that there is no loose dirt, grit, or small pieces that might fall into supercharger while carburetor is being removed.
- (9) Lift carburetor from carburetor adapter.
- (10) Protect supercharger intake with a suitable cover in such a manner that no foreign matter can enter supercharger unit.

Installation is essentially the reverse of removal. However, all bolts joining carburetor to adapter, and scoop to carburetor will be drawn up in such a manner that an even tension is distributed throughout.

In the foregoing instructions no mention is made of the necessary bonding that occurs at many points on this assembly. It is highly important that this be accomplished on re-installation.

CAUTION: During removal and installations of the air scoop and carburetor, extreme care will be exercised to prevent any objects, particularly bolts, nuts, washers, and cotters, from falling into the supercharger intake. If this should occur, the engine will not be turned over or operated until all loose objects have been removed from the supercharger.





PARTS LIST - HOLLEY CARBURETOR 1685 HA (ASSEMBLY)

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Pin Assembly	A-1735
2	2	Screw	A-251
3	1	Nozzle	A-1426
4	1	Channel Assembly	A-1445
5	1	Cover Assembly	A-1331
6	1	Pivot	A-962
7	1	Felt	A-1007
8	1	Wire	A-1156
9	1	Post	A-963
10	1	Bolt	A-1009
11	37	Washer	A-219
12	1	Nut	A-220
13	1	Cam Assembly	A-974
14	1	Lever Assembly	A-1155
15	1	Plate	A-1333
16	1	Screw	A-192
17	4	Washer	A-461
18	17	Screw	A-282
19	4	Bolt	A-58
20	1	Screw	A-491
21	9	Washer	A-238
22	13	Nut	A-280
23	3	Screw	A-272
24	1	Gear	A-20
25	1	Gear	A-19
26	2	Insert	A-185
27	2	Dowel	A-82
28	2	Perch	A-531
29	2	Spring	A-530
30	1	Pin	A-744
31	1	Spring	A-127
32	2	Spring	A-1474
33	1	Diaphragm Assembly	A-2034
34	1	Plug	A-1869
35	1	Gasket	A-1896
36	1	Spring	A-83
37	1	Seat	A-136
38	2	Gasket	A-256
39	1	Plug	A-137
40	1	Valve	A-255
41	1	Spring	A-254
42	1	Spring	A-2006
43	1	Valve	A-2012
44	6	Gasket	A-218
45	3	Nut	A-447
46	1	Spring	A-2000
47	1	Diaphragm Assembly	A-2001
48	4	Gasket	A-445
49	1	Seat	A-2011
50	1	Cover	A-1999
51	3	Screw	A-459
52	1	Comp. Body Assembly	A-2313
53	1	Body Assembly	A-2312
54	6	Screw	A-160
55	1	Body Assembly	A-1817
56	1	Nozzle Group Assembly	A-245
57	3	Gasket	A-1898
58	3	Gasket	A-1899
59			

PARTS LIST - HOLLEY CARBURETOR 1685 HA (ASSEMBLY)

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
60	1-3	Gasket	A-246
61	0-3	Gasket	A-406
62	2	Screw	A-247
63	4	Plug	A-222
64	1	Venturi Assembly	A-1903
65	14	Pin	A-261
66	1	Washer	A-281
67	1	Fitting	A-162
68	5	Key	A-279
69	1	Idle Side Body Assembly	A-1608
70	2	Metering Cover Support Dzus Assembly	A-1150
71	1	Pin	A-78
72	2	Cotter Pin	A-370
73	1	Roller Assembly	A-1008
74	2	Screw	A-248
75	1	Gasket	A-249
76	1	Shaft	A-1162
77	1	Throttle End Body Assembly	A-594
78	1	Gear	A-21
79	1	Screw	A-278
80	1	Gear Side Body Assembly	A-1795
81	1	Stop	A-178
82	1	Bolt	A-292
83	1	Nut	A-259
84	14	Cotter Pin	A-261
85	1	Lever	A-195
86	2	Spring	A-1133
87	1	Venturi Assembly	A-1902
88	1	Brass-Shim	A-2284
89	1	Bearing	A-781
90	1	Disc	A-1997
91	1	Mixture Control End Cap Assembly	A-561
92	1	Cam	A-565
93	1	Ring	A-1075
94	1	Pump Lock Assembly	A-338
95	1	Gasket	A-288
96	6	Washer	A-207
97	1	Venturi	A-588
98	20	Nut	A-1727
99	5	Washer	A-1609
100	1	Stake	A-460
101	1	Gasket	A-449
102	3	Nut	A-447
103	1	Vapor Body	A-2054
104	1	Gasket	A-2072
105	1	Pump Body Assembly	A-2316
106	4	Screw	A-2087
107			
108			
109			
110	1	Screw	A-138
111	1	Pin	A-2291
112	1	Float Valve Assembly	A-2294
113	1	Stem	A-2290
114	2	Gasket	A-1436
115	1	Spring	A-1437
116	1	Gasket	A-252
117	1	Plug	A-1364
118	2	Ball	A-287

PARTS LIST - HOLLEY CARBURETOR 1685 HA (ASSEMBLY)

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
119	3	Gasket	A-345
120	2	Plug	A-227
121	2	Cap Screw	A-1732
122	1	Lever	A-196
123	2	Screw	A-393
124	1	Gasket	A-392
125	1	Inlet Housing	A-843 *
126	1	Jet	A-1324
127	1	Inlet Housing	A-708 **
128	1	Nut	A-709
129	1	Screen	A-711
130	1	Spring	A-714
131	1	Gasket	A-710
132	3	Plug	A-1062
133	3	Shim	A-494
134	3	Shim	A-493
135	3	Nut	A-447
136	1	Spring	A-1939
137	1	Valve	A-1594
138	1	Shell	A-1599
139	1	Seat	A-1597
140	1	Gasket	A-1598
141	6	Dowel	A-102
142	2	Dowel	A-103
143			
144			
145	1	Plug	A-2311
146	1	Gasket	A-252
147	4	Restriction	A-382
148	1	Valve	A-2195
149	1	Spring	A-2197
150	1	Seat	A-2310
151			
152			
153			
154			
155	2	Fuel Valve Seat	A-7
156	2	Fuel Valve Assembly	A-215
157	2	Valve Seat Lock Pin	A-153
158	1	Outer Fuel Diaphragm Group	A-2315
159	2	Support	A-33
160	2	Pin	A-34
161	1	Inner Fuel Diaphragm Group	A-2314
162	2	Diaphragm Lever	A-28
163			
164			
165	1	Vent Ring Group	A-1722
166	1	Idle Adjustment Group	A-2354
167	2	Bolt	A-579
168	6	Screw	A-122
169	2	Spring Assembly	A-1166
170	0-3	Shim	A-499
171	1	Wick	A-359
172	1	Cotter Pin	A-368
173	1	Fulcrum	A-44
174	1	Shield	A-2051
175	2	Stud	A-152
176	1	Clamp	A-451
177	1	Insulator	A-452

PARTS LIST - HOLLEY CARBURETOR 1685 HA (ASSEMBLY)

Ref. No.

178	1	Line Assembly	A-597
179	1	Gasket	A-252
180	1	Screw	A-450
181	4	Screw	A-1385
182	1	Gasket	A-1348
183	1	Gasket	A-751
184	2	Screw	A-429
185			
186			
187			
188			
189			
190	1	Housing	A-1120
191	1	Spacer	A-1038
192	1	Screw	A-1559
193	1	Gasket	A-1349
194	4	Stud	A-404
195	1	Plate	A-1887
196	1	Cover	A-1121
197	1	Support	A-1022
198	1	Stabilizer Valve Lever End Support Assembly	A-1716
199	2	Screw	A-477
200	1	Stabilizer Spring Support Assembly	A-1715
201	1	Spring	A-1028
202	1	Seat	A-1127
203	1	Kick Pin	A-1017
204	1	Valve	A-1025
205	1	Seat	A-1026
206	2	Screw	A-1036
207	1	Gasket	A-402
208	1	Spring	A-1076
209	1	Shaft	A-564
210	1	Pin	A-295
211	2	Gasket	A-619
212	1	Flange Assembly	A-2406
213	1	Gasket	A-1027
214	1	Spring	A-1018
215	1	Ball	A-1016
216	1	Capsule Assembly	A-1031
217	2	Support	A-1034
218	1	Seat	A-1021
219			
220	1	Wick	A-366
221	1	Plug	A-1869
222	1	Gasket	A-1896
223			
224			
225	1	Spring	A-1049
226	1	Spring	A-2019
227	1	Valve Body Assembly	A-2022
228	1	Gasket	A-1066
229	1	Valve	A-2020
230	1	Support	A-2018
231	1	Cover Assembly	A-1731
232	1	Valve Diaphragm Assembly	A-2013
233	4	Nut	A-1726
234	1	Cover	A-1042
235			

PARTS LIST - HOLLEY CARBURETOR 1685 HA (ASSEMBLY)

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
236			
237			
238			
239			
240			
241			
242			

Section *XVI*

FUEL SYSTEM

1. General.

The fuel system of the A-25A Airplane is designed to provide an ample amount of fuel storage space within the airplane structure and for the delivery of this fuel to the carburetors at the proper rate and pressure. It also includes the necessary instruments to give a continuous indication of the system's functioning, and - as a safety feature - a system of diluting entrapped fuel vapors within the fuselage tank with carbon monoxide.

This section will deal with the various units of the system in the following order:

- a. Fuselage Tank
- b. Wing Tanks
- c. Auxiliary Tank
- d. Instrument Lines
- e. Engine-Driven Fuel Pump
- f. Emergency Fuel Pump
- g. Fuel Booster Pump
- h. Fuel Selector Valve
- i. Oil Dilution System
- j. Vapor Dilution System
- k. Carburetor and Primer
- l. Piping and Hose Connections
- m. Strainers and Drains

2. Fuselage Tank.

a. Location.- This tank is located behind the pilot's compartment in the fuselage. (Refer to fig. 2-XVI.) The filler neck is reached through an access door on the left side of the fixed cabin just aft of the pilot's seat. When closed, this door is locked with a Dzus fastener.

b. Description.- All 41- series airplanes and some 42- series airplanes have all metal fuselage tanks; the remainder of 42- series airplanes have self-sealing fuselage tanks. The metal tank is of welded construction. The capacity of the two types of tanks are 90 U. S. gallons (74.9 Imperial gallons) for the metal tank, and 108 U. S. gallons (89.7 Imperial gallons) for the self-sealing tank. Both tanks are held in cushioned cradles by padded metal bands that surround the tank.

Integral with the fuselage tank are the following:

(1) Fuel Content Gage.- An electric liquidometer installed in the center of the aft end of the tank.

S84-SD44-02A

LEGEND
PRESSURE
VENT
SUCTION
DRAIN

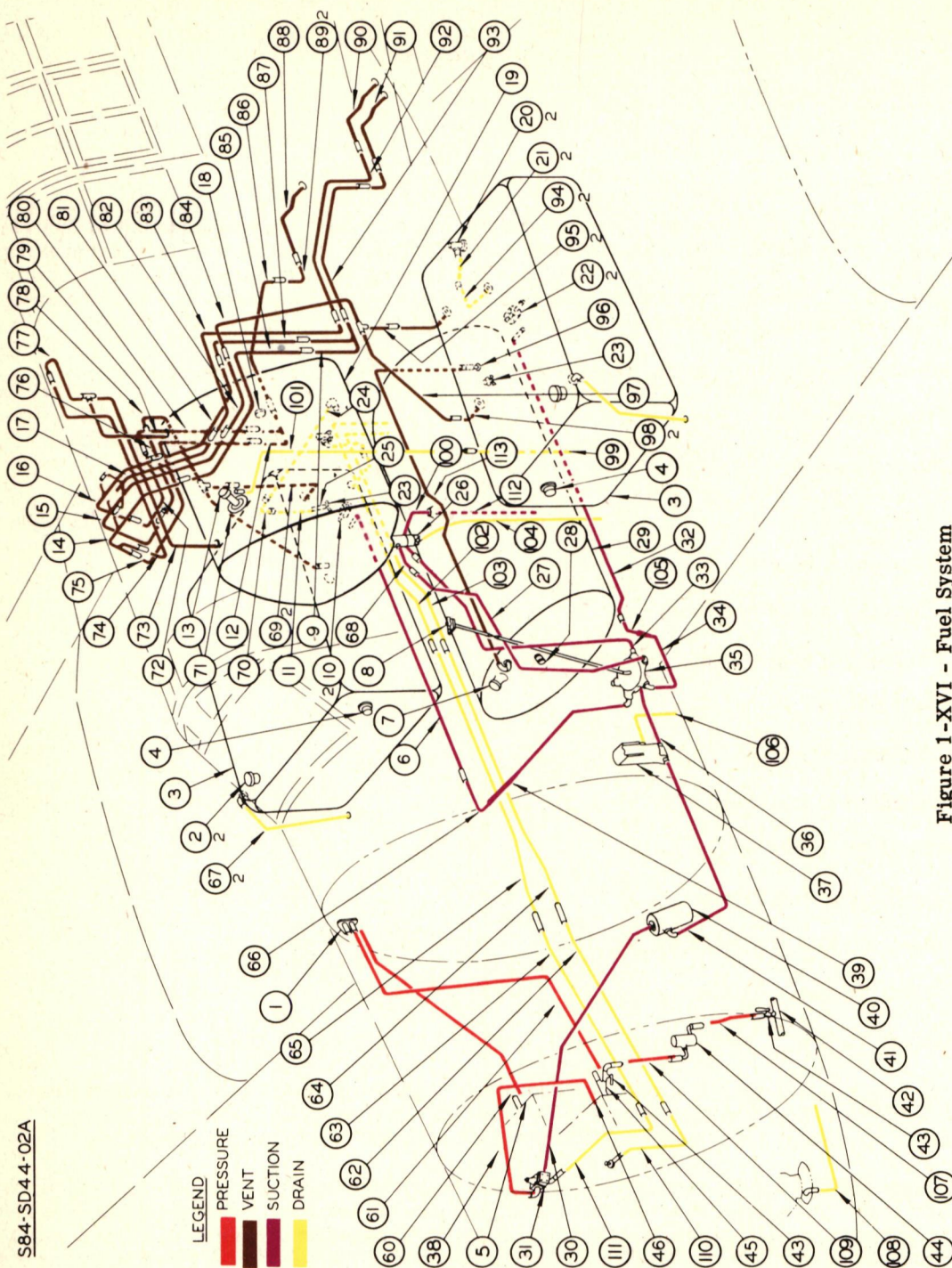


Figure 1-XVI - Fuel System

PARTS LIST - FUEL SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Connector Panel	S84-44-546
2	2	Wing Tank Filler Neck Assembly	S84-45-595
3	1L & 1R	Wing Fuel Tank Assembly	S84-45-508
4	2	Fuel Level Transmitter	S84-45-590-501
5		Supercharger (Ref.)	
6	1	Hose	S84-44-501-19
7	1	Auxiliary Tank Cap Assembly	NAF 67942 *
8	1	Fuel Cock Control Assembly	S84-44-537
9	1	Tube (Weld Assembly)	S84-44-608
10	2	Strainer Assembly	S84-45-566 **
11	1	Hose	S84-44-501-83
12	1	Tube (Weld Assembly)	S84-44-609
13	1	Fuselage Tank Filler Neck Assembly	S84-45-629
14	1	Tube (Weld Assembly)	S84-44-611
15	1	Tube (Weld Assembly)	S84-44-635
16	1	Tube (Weld Assembly)	S84-44-606
17	1	Tube (Weld Assembly)	S84-44-610
18	1	Fuel Level Transmitter	8TJ13LEY (G. E.)
19	1	Fuselage Fuel Tank	S84-44-508
20	2	Wing Tank Drain Assembly	S84-44-572
21	2	Hose	S84-44-501-210
22	2	Sump Fitting Assembly	S84-45-553 ***
23	2	Plug Assembly	AN4043-2
24	1	Hose	S84-44-501-82
25	1	Fuselage Fuel Tank Drain Fitting	S84-44-039
26	1	Booster Pump	TFD8000 (Thompson)
27	1	Hose	S84-44-501-16
28	1	Fuel Level Transmitter	S84-45-532-501
29	1	Auxiliary Fuel Tank	S84-45-502
30	1	Hose	S84-44-501-5
31	1	Engine Fuel Pump	Navy Type H4E3
32	1	Hose	S84-44-501-18
33	1	Hose	S84-44-501-17
34	1	Hose	S84-44-501-97
35	1	Fuel Selector Valve	93940 (Aero Supply)
36	1	Hose	S84-44-501-15
37	1	Auxiliary Fuel Pump	2-E-608-A (Pesco)
38	1	Hose	S84-44-501-4
39	1	Hose	S84-44-501-84
40	1	Fuel Strainer	63701 (Aero Supply)
41	1	Hose	S84-44-501-6
42		Oil System Line (Ref.)	S84-SD46-01
43	2	Valve	NAF1076-11
44	1	Solenoid Dilution Valve	M441-M2 (Air Associates)
45	1	Fitting	AC37A-3528
46		Carburetor (Ref.)	

* This cap is part of auxiliary fuel tank assembly S84-45-502.

** Strainer assembly is part of wing tank assembly S84-45-508.

*** Fitting assembly is part of wing tank assembly S84-45-508.



LINE ASSEMBLIES - FUEL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
60	S84-44-501-609	1	Supercharger to Connector Panel	1/4 x .035	44.00	Alum.Al. 52SO	None None *C*
61	S84-44-501-608	1	Carburetor to Connector Panel	1/4 x .035	34.00	Alum.Al. 52SO	None None *D*
62	S84-44-501-103	1	Hose Connection to Fire Wall	3/8 x .035	35.25	Alum.Al. 52SO	AN818-6D None AN819-6
63	S84-44-501-10	1	Hose Connection to Fire Wall	1/4 x .035	34.00	Alum.Al. 52SO	AN818-4D None AN819-4
64	S84-44-501-50	1	Fire Wall to Union	3/8 x .035	48.00	Alum.Al. 52SO	AN818-6D AN818-6D AN819-6 AN819-6
65	S84-44-501-21	1	Fire Wall to Union	1/4 x .035	46.00	Alum.Al. 52SO	AN818-4D AN819-4D AN819-4 AN819-4
66	S84-44-501-144	1	Right-Hand Wing Tank to Selector Valve	1 x .049	12.75	Alum.Al. 52SO	None None
67	S84-44-501-206	2	Wing Tank Filler Neck to Outside Discharge	1/4 x .035	22.75	Alum.Al. 52SO	AN818-4D None AN819-4
68	S84-44-501-141	1	Fuselage Tank to Fuel Line	1 x .049	10.75	Alum.Al. 52SO	None None
69	S84-44-501-584	2	Wing Tank to Hose Connection	3/4 x .049	5.00	Alum.Al. 52SO	Beaded Beaded
70	S84-44-501-106	1	Fuselage Tank Drain (Elbow)	1 x .049	6.00	Alum.Al. 52SO	None None
71	S84-44-501-577	1	Tee to Hose Connection	3/4 x .049	31.12	Alum.Al. 52SO	AN818-12D Beaded AN819-12

LINE ASSEMBLIES - FUEL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
72	S84-44-501-570	1	From Weld Assembly to Fitting	3/4 x .049	37.00	Alum.Al. 52SO	None
73	S84-44-501-598	1	Fuselage Fuel Tank (Front) To Tee on Vent	3/4 x .049	39.25	Alum.Al. 52SO	AN818-12D None AN819-12
74	S84-44-501-602	1	Tube Weld Assembly to Fitting	3/4 x .049	51.00	Alum.Al. 52SO	None
75	S84-44-501-174	1	Tube Weld Assembly to Tube Weld As- sembly (Right-Hand)	3/4 x .049	36.00	Alum.Al. 52SO	None
76	S84-44-501-172	1	Right-Hand Wing Tank to Vent System	3/4 x .049	26.00	Alum.Al. 52SO	None
77	S84-44-501-603	1	Tee to Fitting	3/4 x .049	24.75	Alum.Al. 52SO	AN818-12D None AN819-12
78	S84-44-501-177	1	Right-Hand Wing Tank to Vent System	3/4 x .049	51.00	Alum.Al. 52SO	AN818-12D None AN819-12
79	S84-44-501-600	1	Tee to Fuselage Fuel Tank	3/4 x .049	13.50	Alum.Al. 52SO	AN818-12D None AN819-12
80	S84-44-501-172	1	From Fitting to Weld Assembly (Right-Hand)	3/4 x .049	26.00	Alum.Al. 52SO	None
81	S84-44-501-170	1	From Weld Assembly to Fitting	3/4 x .049	25.50	Alum.Al. 52SO	None
82	S84-44-501-571	1	Left-Hand Wing Tank to Vent System	3/4 x .049	20.50	Alum.Al. 52SO	None
83	S84-44-501-512	1	Tube Weld Assembly to Fitting	1/4 x .035	60.00	Alum.Al. 52SO	None

LINE ASSEMBLIES - FUEL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>	<u>*A*</u>
84	S84-44-501-175	1	Left-Hand Wing Tank to Vent System	3/4 x .049	35.00	Alum.Al. 52SO	AN818-12D None AN819-12	
85	S84-44-501-173	1	Tube Weld Assembly to Tube Weld Assembly (Left-Hand Side)	3/4 x .049	46.00	Alum.Al. 52SO	None	None
86	S84-44-501-125	1	Vent System to Out- side (Right-Hand Side)	1 x .049	22.00	Alum.Al. 52SO	None	None
87	S84-44-501-120	1	From Fitting to Weld Assembly	3/4 x .049	20.38	Alum.Al. 52SO	None	None
88	S84-44-501-606	1	Vent System to Out- side (Right-Hand Side)	1 x .049	30.00	Alum.Al. 52SO	None	None
89	S84-44-501-119	2	Vent System to Outside	1 x .049	10.62	Alum.Al. 52SO	None	None
90	S84-44-501-607	1	Vent System to Out- side (Left-Hand Side)	1/4 x .035	29.00	Alum.Al. 52SO	None	None
91	S84-44-501-605	1	Vent System to Outside	1 x .049	30.00	Alum.Al. 52SO	None	None
92	S84-44-501-134	1	Vent System to Out- side (Left-Hand Side)	1/4 x .035	27.25	Alum.Al. 52SO	None	None
93	S84-44-501-135	1	Vent System to Outside	1 x .049	31.25	Alum.Al. 52SO	None	None
94	S84-44-501-212	2	Wing Tank to Drain Hose	1 x .049	18.00	Alum.Al. 52SO	None	None
95	S84-44-501-582	1L & 1R	Tee to Hose Connection	3/4 x .049	4.00	Alum.Al. 52SO	AN818-12D Beaded AN819-12	

LINE ASSEMBLIES - FUEL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>	
96	S84-44-501-77	1	Auxiliary Tank Vent Line to Outside	3/4 x .049	4.75	Alum.A1. 52SO	None	None
97	S84-44-501-580	1	Tee to Hose Connection	3/4 x .049	32.00	Alum.A1. 52SO	AN818-12D Beaded AN819-12	
98	S84-44-501-579	2	Wing Tank to Hose Connection	3/4 x .049	3.00	Alum.A1. 52SO	Beaded	Beaded
99	S84-44-501-520	1	Union to Outside Discharge	3/8 x .035	22.00	Alum.A1. 52SO	AN819-6 AN818-6D	None
100	S84-44-501-140	1	Auxiliary Tank to Fuel Line	1 x .049	22.25	Alum.A1. 52SO	None	None
101	S84-44-501-250	1	Scupper to Union	3/8 x .035	34.00	Alum.A1. 52SO	AN819-6 AN818-6D	None
102	S84-44-501-523	1	Union to Outside Discharge	1/4 x .035	44.00	Alum.A1. 52SO	AN818-4D AN819-4	None **
103	S84-44-501-553	1	Union to Outside Discharge	3/8 x .035	40.00	Alum.A1. 52SO	AN818-6D AN819-6	None ***
104	S84-44-501-180	1	Booster Pump to Vent in Fuselage	1/4 x .035	39.00	Alum.A1. 52SO	AN818-4D AN819-4	None
105	S84-44-501-145	1	Tube Selector Valve to Left-Hand Wing Tank	1 x .049	12.38	Alum.A1. 52SO	None	None
106	S84-44-501-182	1	Auxiliary Fuel Pump to Outside Discharge	1/4 x .035	19.00	Alum.A1. 52SO	AN818-4D AN819-4	None

LINE ASSEMBLIES - FUEL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>	<u>*B*</u>
107	S84-44-501-610	1	Solenoid Dilution Valve to Oil Line	1/4 x .035	14.00	Alum.AL. 52SO	None	None
108	S84-44-501-166	1	Drain Cylinder No. 9 to Outside	1/4 x .035	19.95	Alum.AL. 52SO	AN818-4D AN819-4	None
109	S84-44-501-163	1	Carburetor to Solenoid Dilution Valve	1/4 x .035	10.00	Alum.AL. 52SO	None	None
110	S84-44-501-100	1	Supercharger to Hose Connection	3/8 x .035	24.00	Alum.AL. 52SO	None	None
111	S84-44-501-9	1	Engine Fuel Pump to Hose Connection	1/4 x .035	20.00	Alum.AL. 52SO	None	None
112	S84-45-502-28	1	Fuel Outlet Tube Inside Auxilliary Tank	1-1/8 x	19.50	Alum.AL. 52SO	None	None
113	S84-45-502-30	1	Vent From Auxilliary Tank to Outside	3/4 x	80.00	Alum.AL. 52SO	AN817-12D	None
*	Effective on unit 411 and up. Units prior to 411 use -171 tube.							
**	Unit 51 and up. First 50 use S84-44-501-23.							
***	Unit 51 and up. First 50 use S84-44-501-53.							
A	On units 411 and up -576 tube is used in making -175 tube assembly. Units prior to 411, use -176 tube in making -175 tube assembly.							
B	Effective on unit 111 and up. Units prior to 111 use S84-44-501-162.							
C	Effective on unit 111 and up. Units prior to 111 use S84-44-501-13.							
D	Effective on unit 111 and up. Units prior to 111 use S84-44-501-14.							

RESTRICTED

Section XVI

LEGEND

- PRESSURE (Red line)
- VENT (Brown line)
- SUCTION (Purple line)

The diagram illustrates a complex piping system with various components and flow directions. Key components include:

- Pressure Lines (Red):** Connects to a component labeled 11 at the top left.
- Vent Lines (Brown):** Forms a complex network at the top of the diagram.
- Suction Lines (Purple):** Connects to a central component labeled 35 and a bottom component labeled 31.
- Components:** Labeled with circled numbers: 1, 3, 19, 23, 26, 29, 31, 35, 37, 40, 43, 44, 45.
- Flow Direction:** Indicated by arrows throughout the system.

9

(2) Self-Seal Drain.- Located at the bottom-center of the aft end of the tank and connected to another drain valve situated near the right rear corner of the bomb bay. The upper part of this self-seal drain, which extends into the tank, is a perforated brass capsule which contains potassium dichromate - yellowish, orange crystals - which absorbs water present in the fuel and retards corrosion of the aluminum parts of the system.

(3) At the bottom-center of the forward end, is a sump at which point an electric booster pump is located.

(4) The discharge valve of the vapor dilution system is attached at a point at the upper center on the aft end of the aluminum tank, only.

c. Removal and Installation of Fuselage Fuel Tanks.-

(1) Drain all the fuel from the tank and remove the fixed cabin.

(2) Disconnect wires at the fuel indicator and at the booster pump. (Remove the booster pump from the self-sealing tank.)

(3) Remove the forward radio and life raft brace and the cabin control cables.

(4) Remove all the vent lines and fuel lines, including the vapor dilution system lines on the all-metal tank.

(5) Unscrew the turnbuckles. Raise the metal tank from the fuselage. The shell of the self-sealing tank will have to be opened before the cell can be removed.

Installation of the aluminum tank is essentially the reverse of the removal. The installation procedure of the self-sealing cell is essentially the same except that the fore and aft ends of the shell must be assembled to the bottom, before being placed in the fuselage. The cell is then installed in its place, resting in the bottom of the shell. Raise the ends of the shell and thread the wall-supporting threads of the fore and aft ends of the cell through their respective holes and tie them securely. The sides of the shell are then placed in position and the tubing which acts as a "hinge pin" is used to attach them to the bottom of the shell. Carefully thread the cell-wall supporting strings through the proper holes. They are tied securely after the remaining "hinge pins" are inserted in place.

After the cell is completely encased within the shell, the installation should proceed along the same general lines as outlined above.

Inspect all the connections and fittings for tightness before, and immediately after filling the tanks. Take the necessary steps to correct any leaks.

CAUTION: The fuel vapors in the EMPTY tank present a dangerous fire hazard.

3. Wing Tanks.

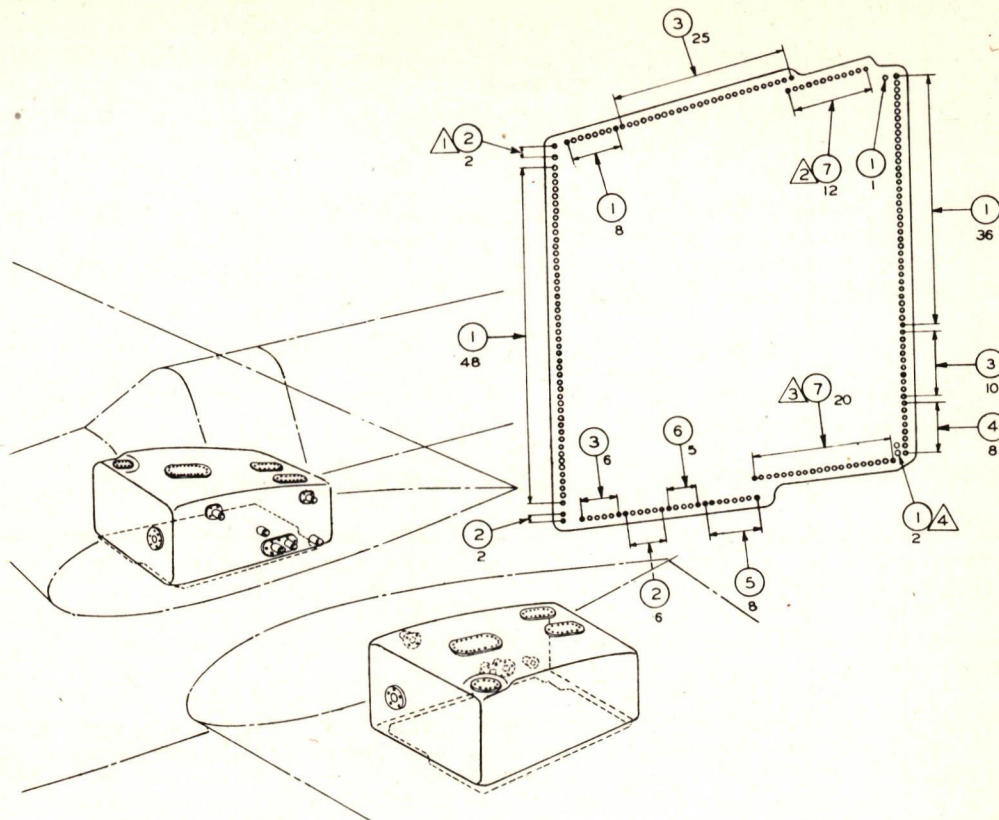
a. Location.- The center panel of the A-25A Airplane was originally designed to incorporate two 118 U. S. gallon (98 Imperial gallon) fuel reservoirs built integrally within the panel. (Refer to fig. 10-II.) These compartments are now utilized to contain self-sealing fuel tanks of 100 U. S. gallons (83 Imperial gallons) capacity. The filler necks are reached through access doors in the top of the center panel.

b. Description.- The construction of these self-sealing tanks consists of the following. (Refer to figure S84-SD44-08, detail A.)

(1) The Liner.- A material which is highly resistant to gasoline and forms the inside of the cell.

(2) The Sealant.- A material which becomes active on contact with gasoline.

(3) The Retainer.- A material which forms the outer covering, built up of leather or tough, rubberized fabric.



PARTS LIST

Ref. No.	Quantity	Item	Part No.
1	93	Bolt	1104-DS-6A
2	10	Bolt	1104-DS-10A
3	41	Bolt	1104-DS-7A
4	8	Bolt	1104-DS-15A
5	8	Bolt	1104-DS-13A
6	5	Bolt	1104-DS-12A
7	32	Bolt	1102-DS-12A

NOTES:

- ① Used on units 272 and up. Units prior to unit 272 used 1104-DS-7A.
- ② Used on units 272 and up. Units prior to unit 272 used 1102-DS-7A (11 only required).
- ③ Used on units 272 and up. Units prior to unit 272 used 1102-DS-7A (18 only required).
- ④ Removed from units 272 and up.

Figure 3-XVI - Wing Tank Door Installation

(4) The shape of the cell is maintained by using bulkheads and stiffeners, advantageously placed, throughout the cell.

(5) A sump, fuel content gage, access doors, and vents are incorporated into the tank.

(6) Fuel outlet fittings are located on the inboard side of the tanks, so positioned that they are accessible from the bomb bay.

NOTE: The right wing tank of some airplanes has two fuel outlet fittings. The upper fitting was used when a reserve supply of fuel was retained in this tank. Since this reserve is no longer withheld, this fitting will be plugged and the lower fitting will be used as the only fuel outlet.

c. Removal.-

(1) Drain all fuel from cells.

(2) Disconnect filler fitting by removing eight studs and two locator screws.

(3) Disconnect electrical conduit connection to fuel quantity gage transmitter. Remove five studs attaching fuel gage transmitter and carefully withdraw the assembly from the tank. Remove the two locator screws.

(4) Loosen hose clamps on the inboard nipple fittings and remove the finger screen strainer. These fittings are accessible through the bomb bay.

(5) Remove the screws holding bottom panel in place. There are four lengths of screws involved. (See fig. 3-XVI showing the location of these different screw length groups.) Support the fuel cell.

(6) Shift the fuel cell outboard, and push the nipple fittings out of the holes through which they protrude.

(7) Place palms of hands on bottom of cell, forward center, and push the fuel cell aft. Push the forward end of the fuel cell inward and work the corners of the fuel cell down past the projecting ledge of the cell cavity. Work the forward end out first and the aft end of the fuel cell out last. When the fuel cell comes out to the position where the nipple fittings are near the projecting ledge of the cell cavity, a thin highly polished paddle-shaped board should be placed adjacent to the nipple fittings to ease them past the projecting ledge.

d. Installation.-

(1) Cover and seal the filler neck hole and fuel transmitting gage hole. Cover the ends of all the nipple fittings with masking tape or equivalent. Dust the outside surface of the fuel cell with talc or soapstone. Dust the inside of the wing cell cavity.

(2) Place hose clamps loosely on vent lines and drain line located inside the bomb bay.

(3) Push the aft end of the cell about two thirds into place. Place palms of hands on forward center part of the fuel cell causing it to bulge and work the forward corners up past the projecting ledge. Use the highly polished board to ease the nipple fittings past the projecting ledge of the cell cavity. Continue pushing on the bottom of the fuel cell forward and aft until the fuel cell is in place. One man should continue to support the fuel cell after shifting the cell as far toward outboard as possible, while another man should take the polished board and insert it up in the wing cell cavity between the fuel cell and the inboard rib or bulkhead and gently push the nipple fittings (one at a time) upward until they protrude through their respective holes. Another method employed is to go into the bomb bay and insert a blunt wooden club (similar to a hammer handle) through the hole and depress the area above the nipple fitting causing the nipple fitting to snap up into position.

CAUTION: Do not break the outer surface of the fuel cell when using the board or hammer handle.

(4) Locator screws are provided, at the holes for filler and gage, for positioning the cell to attach gage transmitter and filler neck to the cell. In order to facilitate proper positioning of the cell, it is recommended "T" shape locator wrenches be used. The wrenches should be approximately eight inches long and threaded at the end to fit the stud inserts at filler neck and gage fitting in cell. Screw the two "T" shaped locator wrenches down into the stud inserts. Pull the fuel cell upwards and at the same time push up on the fuel cell from the bottom. Place in and screw up three studs having no head but a slot to accommodate a screwdriver. Unscrew and remove the two "T" shaped locator wrenches. Secure and tighten the two locator screws. Install the gasket and filler neck adapter. Insert and tighten five cap screws. Remove the slotted head studs that were temporarily installed. Insert, inspect, and tighten the remaining cap screws.

(5) The above procedure is also used in installing the fuel quantity transmitting gage, the only difference being that the "T" locator wrench for this unit is of a smaller diameter. Attach the electrical connection to the transmitting unit.

(6) The lower panel that gives support to the cell will be installed after the three temporary studs have been secured at the filler neck and transmitting unit holes. If this panel were installed before the above mentioned operation, the fuel cell could not be shifted to align the holes.

CAUTION: In the installation of this panel, care should be taken to use the proper length screw in the proper hole. If this is not done, the anchor nuts will be torn off, and it will be necessary to remove the panel to replace the anchor nut. If the torn out anchor nut was located on the forward or aft side of the cell cavity, the fuel cell would have to be removed in order to replace the nut.

(7) Secure the proper lines to the proper nipple fittings. Insert and secure the strainer in the aft hole of the two sump nipple fittings. Tighten hose clamps 1-1/2 turns past finger tightness and safety.

(8) In handling and installing fuel cells, the following general precautions should be observed:

(a) The Goodyear cell installation uses studs at the filler neck and transmitting gage holes, having a "fine" thread. If a U. S. "Royalin" tank is used as a replacement, the studs used must have a "coarse" thread to install and attach the two units referred to above.

(b) The fuel cells have interior supports, baffles, and compartments. Care must be exercised to prevent injury to these interior supports when installing or removing cells. Care also must be exercised in pushing on the cell and bulging the cell. Do not buckle or bend cell at filler top side. Do not use nipple fittings for hand holds.

(c) The aft nipple fitting of the two nipple fittings in the sump is for insertion of the finger screen strainer.

(d) Replace any damaged gaskets.

(e) Be sure cells and compartments are clean.



(f) Keep all fuel cell openings covered while the cell is out of the plane.

(g) Cells should be stored in the cartons in which they are received to prevent crushing or distortion.

(h) Use circulating air to clear cell of residual gasoline and gasoline fumes. Do not use steam.

(i) Use only approved safety-type lights for interior examination of fuel cells.

(j) Refer to T. O. No. 03-10-26, a copy of which is carried on all planes having self-sealing fuel cells, for further maintenance of this cell.

(k) Both vent nipple fittings and the two nipples located at the sump of the Goodyear fuel cell can be replaced. The drain line nipple fitting of the right or left wing tank is not removable, nor is the upper standpipe fuel outlet of the right wing fuel cell removable. None of the nipple fittings of the U. S. "Royalin" fuel cell can be removed for replacement.

e. Repair of Self-Sealing Tanks.-

(1) General.- Before permanent repairs of self-sealing fuel tanks can be accomplished, it is necessary to know what type of material is used for the liner of the tank. While the general repair procedure of all types is nearly the same, the repair materials will differ according to whether the liner is Buna, Royalin, Thiokol, or Neoprene.

Since the A-25A Airplane is equipped with either the Buna or the Royalin-type liner, both are considered in the sequence that follows.

Repairs are divided into three classes.

(a) Emergency, when the damage can be reached without removing the cell from the airplane and when immediate use of the ship is desired. This is classed as a "temporary" repair.

(b) Universal, when the repair must be accomplished with minimum facilities. This is intended for sealing bullet punctures and small damaged areas.

(c) Permanent, when complete facilities are available. Permanent repairs are covered in the chart at the end of this paragraph. Temporary repairs are explained in the following paragraphs.

(2) Compression Plug Method (Emergency).-

(a) Material Needed.-

1. 2 x 3-1/2 elliptical repair clamp (Shrader No. 2402)
2. 2-1/4 x 5 elliptical repair clamp (Shrader No. 2403)
3. 1/32-inch diameter soft wire (about three feet)

(b) Tools Needed.-

1. Special wrench to accommodate a 1/16-inch nut on a four-inch bolt.
2. Wrench No. 5048A. (Dill Mfg. Co., Cleveland, Ohio)

(c) Procedure.-

1. Drain the fuel from the tank and determine extent of injury.
2. Select suitable size compression plug. Remove the 7/16-inch nut and outer compression plate from the screw. Thread 18 inches or 24 inches of wire through the hole in the screw. Insert the elliptical plate with the hinged screw edgewise through the fracture in the skin (enlarge to admit clamp if necessary) and through the walls of the fuel cell until the end of the screw is flush with the wall of the cell.
3. Thread the outer clamping plate over the wire and insert the clamp endwise through fracture in the skin. Increase the tension on the wire and draw the clamp screw outward until the inner liner of the damaged cell and the screw enters the rectangular hole in the outer plate.
4. Align the clamp so that the slots on the screw are parallel with the length of the rupture in the fuel cell and also that the screw is in the center of the rupture.

5. Thread the nut over the wire and run the nut down the screw until the repair plug is clamped securely in place. Caution must be exercised so that the position of the clamp is not disturbed while tightening the nut. Apply the lock nut and secure. If the wall of the tank is in abutment with the skin, the outer clamping plate should be assembled against the outer surface of the skin, thereby securely clamping the skin to the wall of the tank. The edges of the skin should be peened or hammered flat and smooth before the repair is made. Check the repair for fuel leakage.

(3) Animal Glue and Glycerine Repair.- (Emergency - For use when access to the damaged area can be reached through the filler neck, access opening, or sump.)

(a) Materials Needed.-

1. 100 parts, by weight, pulverized animal hide glue.
2. 100 parts, by weight, water.
3. 250 parts, by weight, commercial glycerine, or 150 parts, by weight, Prestone.
4. Suitable container for heating, (for example, a double-boiler).
5. Putty knife, spatula, or flexible piece of wood.

(b) Procedure.-

1. Drain and dry the damaged cell. Ventilate with compressed air, if possible. Clean slushing compound or dirt from liner.

2. Mix water and glycerine and warm in a double boiler to approximately 66 degrees C (150 degrees F). Add the glue slowly, stirring constantly. Continue stirring until the glue is completely dissolved. Heat the mixture to approximately 100 degrees C (212 degrees F). Do not boil.

3. Application of this material is made, while hot, with a daubing action. Apply a heavy coat of the glue material to the damaged area and force well into the ruptured liner, smoothing over with a spatula.

NOTE: This material is soluble in water and should not be used in the vicinity of the sump.

(4) Universal Repair.-

(a) Materials Needed.-

1. One can acetone-solvent No. 1.
2. One can ethyl di-chloride solvent, No. 2.
3. One can synthetic rubber dough, No. 3M EX55257.
4. One can accelerator for above dough, Minnesota Mining & Mfg. Co.
5. One can cement, No. EC-570.
6. One roll repair gum of the following:
 - a. Goodyear fuel cell repair.
 - b. Goodrich fuel cell repair 13 and BT3102.
 - c. Hewitt fuel cell repair 95102.
 - d. U. R. fuel cell repair, one-inch Buna.

(b) Tools and Equipment.-

1. 1/4-inch steel hand roller.
2. 1/32-inch steel plain hand roller.
3. 8-inch or 10-inch shears.
4. Sharp shoe knife.
5. Mirrors.
6. One-inch paint brush.
7. No. 40-80 emery cloth.
8. Spatula.
9. Rags, clean, lintless.

(c) Before Starting Repair.-

1. Drain fuel from cell and allow it to dry. Allow swollen areas to return to normal. Water should be removed and any damp or wet areas should be swabbed with acetone.

2. Remove slushing compound from inner liner with rag dampened with ethyl acetate, or by buffing.

3. Buff the inner liner thoroughly four inches in all directions from the injury. If cell exterior is accessible, buff the damaged area three inches in all directions from the injury until the fabric cords are exposed.

4. Open and align the injury; then swab the area with ethyl di-chloride.

(d) Repair of Interior.-

1. Stir the accelerator thoroughly before using.

2. The dough is prepared by adding ten parts of accelerator by weight to 100 parts of dough by weight and mixing thoroughly. The dough becomes lively upon the addition of the accelerator and considerable force must be used to mix it properly.

CAUTION: Do not mix more dough than is necessary. Do not use dough that is tough, tacky, or more than two hours old. Use a blunt spatula and work the dough like putty when applying.

3. Place the dough over the injury on the interior of the cell. Force the dough well into the injury and build the repair 1/8-inch deep extending 1/2-inch in all directions from the injury and tapering off to the liner to form a smooth surface.

4. Cut a patch of repair gum that will extend three inches in all directions from injury and buff one side of patch to remove gloss. Clean buffed patch and repaired cell surface with solvent No. 2. Allow to dry. Apply a medium coat of cement No. EC-570 to the repaired area and the buffed surface of the patch. Allow to dry 10 or 15 minutes. Swab lightly with solvent No. 2 to make surface tacky.

5. Apply patch as follows: Center over dough-covered area and stitch one edge of patch down. With the 1/4-inch steel roller, roll the edges down and gradually roll down to the other end of the patch using a traversing movement, moving the roller perpendicular to the longer dimension of the patch and advancing as the patch is stitched down. Over-lapping strokes of the roller prevent any loose spots or blisters.

CAUTION: Do not allow the patch to come in contact with the dough until it is stitched down or air will be trapped. Re-roll edges.

6. Allow the patch to set for one-half hour or more, then place one coat of cement No. EC-570 on the patch and the buffed area surrounding the patch. Allow the tank to dry for 24 hours at 38 degrees C (100 degrees F), before filling with fuel.

CAUTION: Do not exceed 49 degrees C (120 degrees F).

f. Repair of Exterior Area of Cell, When Accessible.-

NOTE: Support the interior repaired section to prevent sagging and straining.

(1) Dough and Patch Method.- Place a quantity of dough on the buffed exterior area of the cell surrounding the injury and work the dough over an area to a depth of 1/4-inch, and extending two inches in all directions from the injury. The dough should be tapered to form smooth contour with the cell surface. Apply patch as outlined in paragraphs 4, 5, and 6 above.

(2) Patch Method.-

(a) Cut a patch slightly smaller than the buffed area on the exterior of the tank and buff one side of the patch to remove all gloss. Clean the patch and buffed surfaces with solvent No. 2. Allow to dry. Apply one coat of cement (No. EC-570) to the exterior of the cell and one coat to the buffed side of the patch. Allow to dry 15 minutes.

(b) Apply a second coat of cement to the cell. Allow to dry 15 minutes. Swab the cemented surfaces lightly with solvent No. 2, and apply the patch in the same manner as noted in repairing the interior of the cell. Allow the patch to dry for one-half hour and paint the patch and the buffed area adjacent with one coat of cement (EC-570). Allow the patch to dry at least 24 hours at 38 degrees C (100 degrees F), before filling with fuel.

g. Re-installation of Goodrich Elliptical Inspection Door.-

(1) Material.-

- (a) Ameripol sheet .025 gage.
- (b) Goodrich cement No. 868, B & B Chemical Co.
- (c) Cement No. M-40 Bostik synthetic, B & B Chemical Co., Cambridge, Mass.
- (d) Zinc chromate.

(2) Tools.-

Same as other repairs.

(3) Procedure.-

- (a) Remove Ameripol sheet from inside faces of inner and outer door rings.
- (b) Remove Ameripol sheet from edges and inside and outside faces of the door and opening in the cell.
- (c) Treat inside faces of door rings with two coats of B & B No. 868 cement.
- (d) Cement strips of Ameripol repair sheet with one coat of B & B No. 868 cement and apply to face of rings. Make butt splices in Ameripol sheet when applying it to the rings.
- (e) Punch out Ameripol sheet over holes in rings.
- (f) Cement edges, inside and outside faces of the door and opening in the cell, with two coats of Bostik No. M-40 cement. Cement area originally covered by door rings.
- (g) Cut strips of Ameripol repair sheet of sufficient length and width to re-cover areas on door and openings in cell originally covered by Ameripol.

(h) Paint Ameripol strips with one coat of B & B No. 868 cement and two coats of Bostik No. M-40 cement.

(i) Apply Ameripol sheet to edges of door and cell opening; then flange strips to cover inside and outside faces.

(j) Punch out Ameripol sheet over holes.

(k) Replace any Nipol bushings that have been damaged or lost. Dip bushings in B & B No. 868 cement before inserting in holes.

(l) Cement Ameripol sheet on face of rings with two coats of Bostik No. M-40.

(m) Position inside ring against inside cell wall. Insert steel mandrels through holes and thread into nuts on ring to position ring accurately around opening in cell wall and to line up holes in ring with holes in cell wall. Insert a mandrel in every fourth or fifth hole.

(n) Apply two coats of Bostik No. M-40 cement to edge and inside face of door that will contact inside ring.

(o) Place door in position, lining up screw holes by inserting mandrels and threading into nuts on inside ring.

(p) Apply two coats of Bostik No. M-40 cement on the face of the outside ring.

(q) Place outer ring in position over protruding mandrels.

(r) Place brass tubes over mandrels and screw on nuts. Tighten to pull door and rings into position.

(s) Dip door screws in zinc chromate paste and insert screws and tighten.

(t) Remove steel mandrels and replace with screws.

(u) Plug fittings of cell. Inflate with air. Test for leaks by applying a heavy soap solution around door and fittings.

(v) Wash soap from door area.

(w) Cement cowhide door cover in place with Bostik No. M-40.

(x) Gasoline-proof areas where original protective covering has been removed by applying two coats of Bostik No. M-40.

4. Auxiliary Fuel Tank.

a. Description.- The normal fuel supply of the A-25A Airplane can be augmented, whenever necessary, by the installation in the bomb bay of an auxiliary fuel tank (see fig. 5-XVI). The filler neck of this tank is located at the forward end and access to it is through the bomb bay door.

The tank is suspended from the center bomb rack and is held secure by the outboard sway braces. (The inboard sway braces having been temporarily disconnected as outlined, subsequently.)

The material of the tank is 3S-1/2 H aluminum alloy sheet, with the front and rear ends welded to the shell. Interior bulkheads and stringers are riveted to the tank shell. All tanks are constructed to withstand an internal pressure of three pounds per square inch above atmosphere.

The auxiliary tank has a rated capacity of 130 U. S. gallons (108 Imperial gallons).

Gasoline is fed into the fuel system from the tank through a standpipe located in the top center.

84-3044- 11

GOODYEAR BUNA LINED TANKS		U. S. ROYAL ROYALIN LINED TANKS	
Materials Needed		Materials Needed	
Cement, inside or outside, - B & B Chemical Co. No. 868		Cement, inside or outside - U. S. Rubber Co. Royalin Cement	
Methyl ethyl ketone liner repair of any of the following: (a) B.F. Goodrich nylon sandwich No. 139BT3102 (b) Goodyear Tire & Rubber Co. cell repair gum B. (c) Firestone Tire & Rubber Co. nylon fuel cell material No. 95102 (d) U.S. Rubber Co. Buna repair material No. 1. (e) Hewitt Rubber Corp. nylon sandwich fuel cell repair material No. 85612		Inside seal coat - Minnesota Mining & Mfg Co. No. E0562 Solvent - Ethylene dichloride Repair material, inside and outside - U.S. Rubber Co. Royalin plasticcoat No. 38901 fabric, impregnated with M8002 cement fabric.	
NOTE: Always drain and dry cells as soon as possible after injury. This may be done most quickly by rapid air circulation inside of cell and by keeping it in a warm place. During this drying time, cell should not be kept warm for long periods of time and should not attain temperatures over 490 C (1200 F). Higher temperatures will cause the gasoline soaked sealant adjacent to the injury to dry out more quickly and thereby trap gasoline. This trapping of gasoline soaked sealant material will cause separation and breakdown in the sealant material. Therefore the opening or injury should be spread slightly with a small object to expedite the evaporation of the gasoline from the sealant material around the injury. Repair may be started when sealing gum has resumed its natural appearance and is no longer swollen.		Remove all gasoline from cell and allow it to become thoroughly dry. This may be done most quickly by rapid air circulation inside of cell and by keeping it in a warm place. During this drying time, cell should not be kept warm for long periods of time and should not attain temperatures over 490 C (1200 F). Higher temperatures will cause the gasoline soaked sealant adjacent to the injury to dry out more quickly and thereby trap gasoline. This trapping of gasoline soaked sealant material will cause separation and breakdown in the sealant material. Therefore the opening or injury should be spread slightly with a small object to expedite the evaporation of the gasoline from the sealant material around the injury. Repair may be started when sealing gum has resumed its natural appearance and is no longer swollen.	
INSIDE REPAIRS		CORNER REPAIRS	
"SLIT" TYPE DAMAGE	"HOLE" TYPE DAMAGE	INSIDE REPAIR	OUTSIDE REPAIR
NOTE: It is recommended that inside repair be made before outside repairs.		NOTE: Gum and cell are prepared and cemented in the prescribed manner, but greater care is required in rolling down. The repair, to be serviceable, must be made without wrinkling or stretching the patch.	
1. Remove slushing compound with a clean rag dipped in solvent. Allow to dry.	1. If the injury consists of a hole in the cell material blown out, rather than slit or cut, it will be necessary to replace the material that is missing with a plug insert and then proceed with repairs as outlined in column to left.	1. Measure size of hole or injury and mark outline for size of patch which shall extend 2-1/2 inches beyond the edges of the injury. Cut smooth, round or oval patch of outside repair fabric to conform with marked outline.	1. Distortion can be avoided by a single slit made in the patch extending radially from the center to the edge of the patch, which will form the apex of the corner. Before any cement is applied the patch should be fitted into the corner, trimmed to size, and the slit made so that the lap will be on the flat side and as far away from the injury as possible. Outline of patch should be drawn on the cell with a blunt instrument while the patch is still in the correct position so that it can be returned to that position after cementing.
2. Mark off area so that patch will extend 2 inches beyond injury.	2. Cut away the cell material along a line around the injury by holding a knife at a 45-degree angle. The opening on the inside should be slightly less in diameter than the outside.	2. Buff one side of patch and cell for three inches in all directions from edge of injury with emery cloth. Buff until a considerable number of cords show through.	1. Outside corner repairs are made in the same manner as the inside repairs, but following the specified outside repair procedure, described in column three. Just one patch is used, but lap should be covered with a strip of fabric, using specified outside repair procedure. Strip should extend one inch on each side of outside edges of lap, and from apex of corner to outer edge of patch.
3. Remove all gloss on inside by buffing for 2-1/2 inches in all directions around injury. Buff thoroughly and then with clean cloth dampened with solvent, remove grit.	3. Make a plug of the same material to fit this hole. Buff the liner side of the plug. Paint plug with solvent and insert. Apply internal patch as described in column to left.	3. Moisten a clean rag with solvent and wash buffed surfaces of tank and patch. Apply two coats of cement to each surface. Let dry between each coat.	
4. Cut inside repair gum with skived edges so that an obtuse angle will be formed between the tank surface and the edge when the patch is placed over the injury. Buff skived edges to paper thinness. Flat side of patch is applied next to lining of cell with the tapered side away from it.	4. Buff the vulcanized side of the patch and an area extending 1-1/2 inches from the edge of the patch. Wipe with solvent to remove grit and apply coat of cement. After this coat dries apply a second coat.	4. When last coat is dry, but slightly sticky, center the patch over the injury and roll down as specified for inside patch. After this patch has been applied, paint its edges and buffed area of cell with four coats of synthetic cement.	
CAUTION: Always prepare cement just before using.	5. Cut a patch of repair gum large enough to extend over the entire surface of the newly applied patch and 1 inch beyond the edge of the first patch and buff edges to paper thinness.	5. If injury is 2 inches or larger in size, a second patch should be applied overlapping all edges of the first patch at least one inch.	
5. Support liner around injury so the edges of the injury will be in proper alignment. Wash buffed surfaces of tank and unvulcanized surface of patch. Apply a thin coat of cement to the buffed area around the injury, and the unvulcanized side of the patch.	6. Apply 2 coats of cement allowing each to dry before applying a second coat to the unvulcanized side of the repair patch. After cement has dried, place over the first patch and roll down, avoiding all blisters or air bubbles wherever possible.	6. After rolling down, apply cement to the surfaces that will form the lap in the prescribed manner; being careful to coat well the inner end of the slit in the patch and roll down. Care must be taken at this point to be sure that all edges are securely rolled down and over.	
6. If the last coat of cement has become too dry, it may be made tacky by wiping gently with clean rag, dampened with solvent, or by applying another thin coat of cement. If this fails to hold, the patch should be removed and the cement moved and the repair started anew.	7. If after the repair has been made, there are any bubbles, blisters, trapped air or evidence of loose areas, the patch should be removed and the repair started over.	7. The patch is then worked down with the gooseneck roller, proceeding from the stuck-down edge around patch to the outer edge carefully, observing prescribed procedure to avoid wrinkles and trapped air.	
			8. If parts of patch around the edges do not stick down well, wipe loose edge with clean, lintless rag dampened with solvent. Let dry a short time and re-roll. If adhesion is still poor, apply one more coat of cement, let dry and roll down. If patch is still loose at any point, it should be torn off and scrapped, tank cleaned of cement, and repair started over.

NOTE: If the cell has been previously slushed, paint the entire patch area with two coats of Fuller's slushing compound No. 71-284. The cement around the edges of the patch should be dried thoroughly before applying any slushing compound. The first coat of slushing compound should be made with the compound diluted with 30 percent ethyl acetate by volume, the second coat with a compound diluted 15 percent ethyl acetate by volume.

(Repair of large hole injuries or long tears exceeding ten inches is not considered advisable, although in dire emergencies they can be repaired as outlined above. Such tanks should not be considered permanently repaired or permanently usable.)

Figure 4-XVI - Permanent Repair of Self Sealing Tanks Chart

The fuel content gage is located slightly off center on the front end, and a tank drain is located at the lowest point in the shell at the rear of the tank. As with the fuselage tank, this drain incorporates a perforated brass capsule, which extends into the tank and contains potassium dichromate crystals to retard corrosion. A vent is located at the top center of the front end and the vent line extends across the top and down the rear of the tank. This arrangement prevents any loss of fuel during a dive.

b. Installation.-

(1) Unfasten the lower connection of the forward-inboard sway braces and tie them securely back against the strut to which they are fastened. Remove the rear inboard sway braces from the airplane.

(2) Release the fuselage bomb rack hooks by pulling the A-3 bomb release handle into "SALVO" position.

(3) Loop a cable under the locking device on the center bomb rack. Extend cable over center rack and over left-hand rack. Pull the cable taut to prevent it from slipping from the locking device (see fig. 5-XVI). Approximately nine feet of 1/16 inch 7 x 7 cable will be sufficient.

(4) Place the center line of the tank in relation to the center line of the airplane, having the filler cap forward. Elevate the tank to approximately six inches from the stowed position and connect the standpipe to the gas line leading to the fuel selector valve. Continue raising the tank until the front and rear supports are in position for engagement with the locking hooks in the bomb rack. Pull cable and lock tank in position.

S84-SD44-22

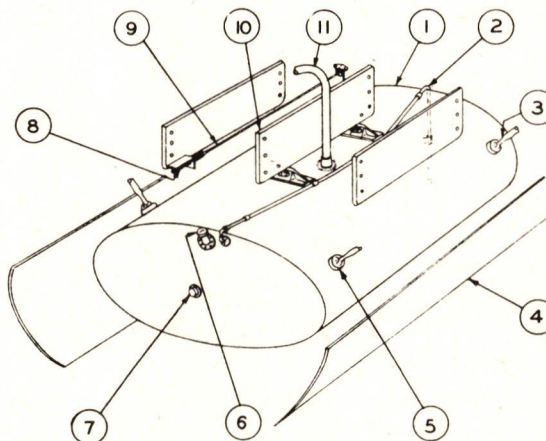


Figure 5-XVI - Auxiliary Fuel Tank Installation

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1		Auxiliary Fuel Tank (Ref.)	S84-SD44-02
2		Vent Line (Ref.)	S84-SD44-02
3		Sway Brace (Ref.)	S84-SD70-05
4		Bomb Door (Ref.)	S84-06-504
5		Sway Brace (Ref.)	S84-SD70-05
6		Auxiliary Tank Cap Assembly (Ref.)	S84-SD44-02
7		Fuel Level Transmitter (Ref.)	S84-SD44-02
8	1	Spring	S84-69-403
9	1	Cable Assembly	S84-70-564-21
10		Bomb Rack (Ref.)	S84-SD70-05
11		Hose (Ref.)	S84-SD44-02

- (5) Connect fuel gage plug at forward end of fuel tank.
- (6) Adjust sway braces to hold tank snugly equi-distant from bomb bay walls and other bomb bay mechanism.
- (7) Remove cable from locking device.

5. Fuel System Instrument Lines.

- a. Fuel Pressure Gage.- This gage line is connected to the carburetor. It should require little attention except inspection for leaks. The care of the gage is described in section X.
- b. Manifold Pressure Gage.- This gage line is connected to the engine supercharger section. It should require little attention. The care of the gage is given in section X.
- c. Fuel Quantity Gages.- These gages are electric liquidometers and are discussed in section X. They are controlled by the switch marked "Fuel Level Gage and Howler" on the main switch box.

6. Engine-Driven Fuel Pump.

- a. Purpose in System.- The function of the engine-driven fuel pump is to furnish a positive, non-pulsating supply of gasoline to the carburetor, after the engine has started.
- b. Location.- This pump is mounted on a pad on the right side of the engine accessory case
- c. Description.- This fuel pump may be any one of the following, each conforming to the AAF G-9 or AN4I01 type:

- (1) Pesco, model 2P-R600-CWT (Old No. R-600-CWT)
- (2) Ceco, model 9107.
- (3) Thompson, model TFD-100.

Each of these pumps is of the rotary, positive displacement type. A pressure relief valve is provided to return excess fuel from the discharge port back to the intake port, when the discharge pressure overcomes the tension of the pressure control spring. A bypass valve, to allow unrestricted flow of fuel from another pump in the fuel system, is also provided. It is not adjustable.

d. Operation.- The bore of the pump is not a true circle, but so developed in contour, and the vanes so spaced that the delivery of fuel is constant and free from fluctuations and pulsations. As the rotor turns, the projecting blades sweep through the clearance space formed by the off-set rotor, in succession, thus creating a depression or suction on the inlet side of the pump. Since the fuel cannot be compressed, it is forced out through the discharge port.

e. Removal.-

- (1) Turn the selector valve to "OFF" position.
- (2) Drain fuel from lines ahead of selector valve by opening drain at the bottom of the fuel strainer housing.
- (3) Remove the outlet and inlet hoses from the pump.
- (4) Remove the drain line connection at the pump.
- (5) Sever the safetying and remove the four nuts that hold pump to mounting pad. Remove bonding cable from stud.
- (6) Remove the pump.

(7) Cover the mounting pad with a suitable cover to prevent entry of foreign matter.

f. Installation.- A gasket in good condition should be used to seal the pump flange joint. Before installing a pump, remove the two shipping plugs from the ports, drain out excess oil, wash with clean gasoline or cleaning fluid, and then test for freedom of rotation. The pump should feel smooth when rotated by hand, although it may be fairly stiff by reason of the shaft seal surfaces being dry. It is permissible to use a small key or adjustable pliers on the driver in this test, but undue forces should never be exerted. If there is a catch or point of severe resistance when rotated by hand, the presence of foreign material is indicated. If re-washing fails to remove the obstruction, return the pump to a depot for repair.

In this installation, the pump must be installed with the relief valve body uppermost. The inlet line from the selector valve is connected to the aft end, and the outlet to the carburetor is on the forward end. This may be checked by noting the direction of rotation as indicated on the pump name plate for the inlet port, and then noting the direction of rotation of the fuel pump drive shaft.

After the intake and discharge lines are installed, noting that the pump port and line fitting threads are in good condition for gasoline-tight joints, connect the drain line. This is a 1/4-inch O.D. line. There are four pump shaft seal chamber drain holes in the pump body next to the mounting pad. The lowest one, while the plane is resting on the ground, should be used. This drain line is intended to carry away any fuel that may work past the seal, therefore it must be free of traps that would prevent drainage.

g. Special Instructions.-

(1) Relief Valve Adjustment.- If valve spring pressure adjustments are necessary, proceed as follows:

(a) Pesco or Ceco Pumps.- Loosen the lock nut and turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Adjust the valve to maintain pressure from six to seven pounds per square inch above 1000 rpm. Tighten and safety lock nut after adjusting pressure.

(b) Thompson Pump.- Remove the hexagon valve cap nut. Insert a screwdriver in the slot in the upper relief valve body; this will lift the pivoted adjusting screw lock plate high enough to raise it clear of the notches in the thrust washer. Turn the adjusting screw to the right (clockwise) to increase the fuel pressure. Adjust the valve to maintain pressure from six to seven pounds per square inch above 1000 rpm. Re-install the hex-valve cap nuts after adjustment is completed.

(2) Inspection and Lubrication.- Do not apply grease through the drain openings. At every 100-hour inspection period, lubricate the Pescopump by pressure gun through one of the 1/8-inch P.T. openings in the mounting pad. Use grease conforming to Specification No. VV-G-681. The drive shaft and coupling parts of the Thompson pump are lubricated by engine oil which finds its way onto the pump drive. The Ceco pump does not require any lubrication between overhaul periods.

25-Hours.- Inspect the vent openings in the relief valve upper body or cover plug by inserting a wire or drill of the proper size in the vent opening. Inspect for leaks, proper operation, and security of mounting.

(3) Maintenance.- In case of faulty operation of the relief or bypass valve, remove this valve assembly, and inspect for foreign matter that may have been lodged on the valve seat, valve, and valve stem guide. Wash the parts thoroughly and check the valve stem and guide for easy action. See that no foreign matter is imbedded in the neoprene facing of the bypass valve and that the air vent line is free from obstructions.

7. Emergency Fuel Pump.

a. Purpose.-

(1) To prime the engine before starting and to furnish fuel to the engine-driven pump while starting. Also to be used for take-off.

S84-SD44-14

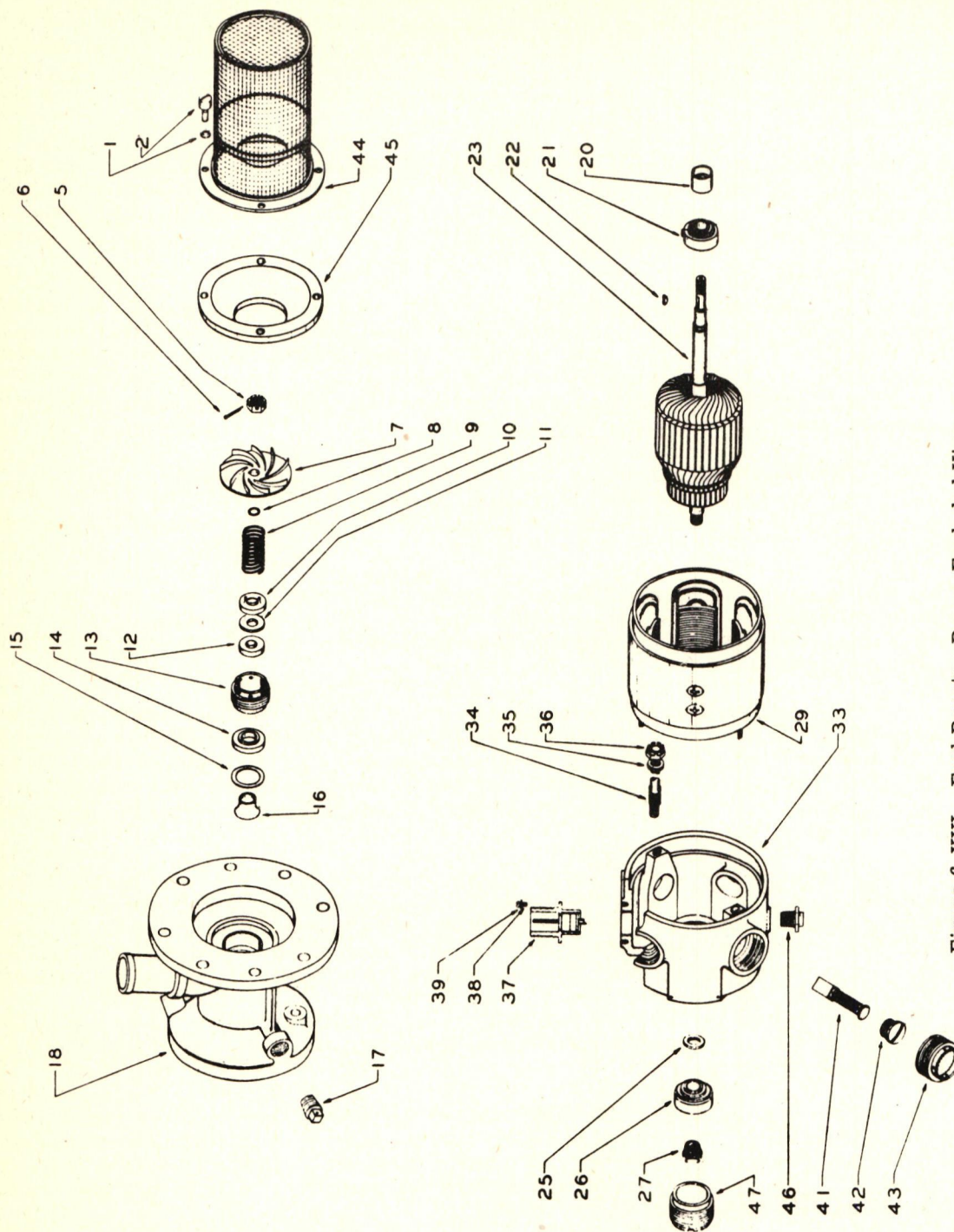


Figure 6-XVI - Fuel Booster Pump, Exploded View

PARTS LIST - FUEL BOOSTER PUMP - EXPLODED VIEW

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	4	Plain Throat-Washer	AN960-8
2	4	Fillister-Head Throat-Screw	AC500A8-5
5	1	Impeller Nut	AN320-3
6	1	Impeller Cotter Pin	AN380B2-2
7	1	Impeller Assembly	TFA-7410
	1	Impeller Body	TFA-6071
	1	Impeller Blade	TFA-7412
8	As Req.	Impeller Shim	TFA-6013
9	1	Seal Spring	TFA-6020-1 *
10	1	Seal Cup	TFA-6074 **
11	1	Seal Cushion	TFA-6075
12	1	Rotating Fuel Seal	TFA-6073
13	1	Seal Nut	TFA-6723
14	1	Stationary Fuel Seal	TFA-6072
15	1	Seal Gasket	TFA-6019-1
16	1	Shaft Slinger	TFA-6024
17	3	1/8-inch Pipe Plug	AC895-B70
18	1	Frame Assembly - Booster	
		Pump Body End	TFA-8205
	1	Booster Pump Body	TFD-7406
	1	Labyrinth Stationary Seal	TFA-6705
20	1	Labyrinth Rotating Seal	TFA-6727
21	1	Pump End Bearing	1064017
22	1	Impeller Key	5337377
23	1	Armature Assembly	TFB-8009
25	1	Commutator End Bearing Washer	5343464
26	1	Commutator End Bearing	5343536
27	1	Bearing Inner Race Retaining	
		Self-Locking Nut	AC365-D-428
29	1	Frame and Coil Assembly	TFA-8008
33	1	Commutator End Frame Assembly	TFA-8030
	1	Commutator End Frame	TFD-7431
	2	Brush Holder Assembly	5361498
	2	Insulating Washer	5348851
	2	Brush Holder	5361781
	1	Jumper Lead	5348853
	1	Brush to Receptacle Lead	5354512
34	2	Thru Stud	TFA-6747
35	2	Thru Stud Washer	AN960-10L
36	2	Thru Stud Nut	AN310-3
37	1	Receptacle	AN3102-16S-4P
38	4	Receptacle Screw	AC500-4-4
39	4	Receptacle Lock Washer	AC936-A4
	1	Name Plate	TFB-6752 ***
	4	Drive Screw	AN535-O-3
	1	Mounting Gasket	TFA-6307
41	4	Brush Assembly	1072964
42	4	Brush Holder Cap Screw	5343971
43	4	Brush Cover Nut Assembly	5368691
44	1	Booster Pump Screen	TFB-8103
45	1	Booster Pump Throat	TFA-7402
46	1	Vent Plug Assembly	TFA-6754
	1	Vent Plug Body	TFA-6755
	1	Variable Pressure Booster	
		Rheostat Assembly	TFA-8060
	1	Rheostat Stop	TFA-8061
47	1	Bearing Outer Race Retaining Nut	5360739

- * Old No. TFA-6020. Replaced with stiffer spring to reduce change of seal leakage. Identification: Old spring has 7-1/2 total coils; new spring has 9 total coils.
- ** Interchangeable with TFA-6076. Minor difference in design.
- *** New No. TFB-6752-1. Redesigned.

S84-SD44-15

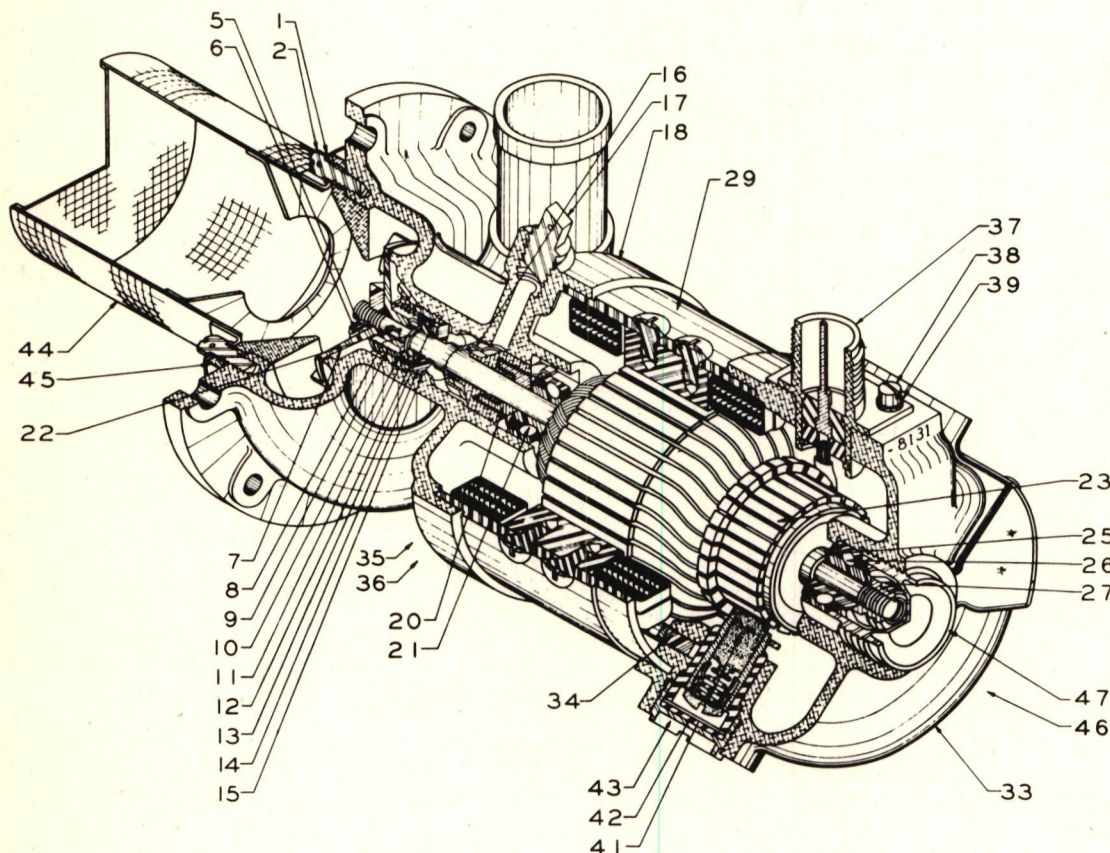


Figure 7-XVI - Fuel Booster Pump, Detailed Assembly

(2) As directed by T. O. No. 03-10-28, to eliminate possible engine failure due to fuel vapor lock, the emergency pump will be operated:

- (a) At all times during take-off and landing. (Use lower speed.)
- (b) At all altitudes below 1000 feet. (Use lower speed.)
- (c) At all altitudes above 10,000 feet.
- (d) Between 1,000-foot and 10,000-foot altitudes, when conditions warrant.

b. Location.- The emergency fuel pump is mounted just forward of the fuel selector valve about midway between the fire wall and the first bulkhead aft (refer to figure). It is easily accessible through the target approach door.

c. Description.- The emergency fuel pump is a motor-driven assembly, Pesco No. 2E-608A, which differs from the engine-driven pump of the same make only in its body. The principle of operation is the same, thus conforming to the AN-4101 (Army G-9) designation. The part number of the body is "R-600-82"; all other parts are identical.

The motor is a 24-volt, direct current, explosion-resisting unit. The speed of the motor is constant, and fuel pressure is controlled by a relief valve in the pump.

d. Operation.- Power to the motor of the pump is controlled by a switch on the main switch box panel. As stated in paragraph c, operation is identical to that of the engine-driven pump.

e. Removal.-

- (1) Ascertain that fuel selector valve is at the "OFF" position.
- (2) Drain fuel from lines ahead of the selector valve by opening drain at the bottom of the fuel strainer housing.
- (3) Remove the outlet and inlet hoses from the pump.
- (4) Disconnect the vent line.
- (5) Disconnect the electrical connection.
- (6) Remove the four self-locking nuts.

f. Installation is essentially the reverse of removal except that all connections should be checked for leaks after fuel has again been introduced into the lines.

g. Special Instructions.-

(1) Inspection and maintenance for this pump is the same as that for the engine-driven pump, except that the emergency pump shall be set to develop pressure of nine pounds per square inch.

(2) At each 100-hour inspection period, the motor brushes should be checked for length and freedom of movement. Before removing the brushes, each one should be marked so that they may be re-installed in their original positions. If brushes do not slide freely in the holders, carefully dress the sides with "00" sandpaper laid on a flat surface. Do not use emery cloth. Be sure to remove any burs from the wearing edge of the brushes.

Replacement of brushes, without refinishing the commutator, is not recommended. However, if brushes are found to be 1/4-inch in length or less, they may be replaced until the next inspection period without refinishing the commutator, but the wear of these newly installed brushes will be abnormal.

The bearings of the motor and the adapter are grease-packed and require no lubrication.

8. Fuel Booster Pump. (See fig. 7-XVI)

a. Purpose in System.- The fuel booster pump supplies vapor-free fuel under pressure from the fuselage tank to the fuel system.

b. Location of Units.- The pump is mounted directly to the sump of the fuselage tank (refer to fig. 1-XVI). The electrical controls are mounted on a panel, adjacent to the trim tab controls, on the left-side of the fuselage.

c. Operation.- When the pump is operating, fuel is drawn into the impeller, where it attains a high velocity, with consequent reduction in pressure, resulting in formation of vapor. The vapor is thrown out radially by the impeller blades and escapes to the surface of the tank, while liquid fuel is discharged under pressure into the fuel line.

d. Description.- The fuel booster pump is a centrifugal-type pump constructed integrally with a 24-volt, dc, electric motor. A standard AN receptacle is provided for electric connections. A screen is provided to prevent foreign matter reaching and damaging the impeller. Since it does not have positive displacement, no relief valve is necessary.

e. Removal and Installation.-

(1) Removal.- To remove the booster pump, the following procedure will be followed:

- (a) Remove the electrical connection to the pump motor.
- (b) Remove the flexible hose connection to the drain.
- (c) Remove the self-sealing hose from the pump discharge nozzle.

(d) Remove the eight stud bolts holding the pump unit to the bottom of the sump. Do not allow the unit to fall. If the mounting gasket is damaged, it should be removed and the mounting flanges on the pump and sump cleaned.

(2) Pre-Installation.- Before installing, wash the impeller chamber with clean gasoline and test for free rotation. Use fingers only for this test. The slightest catch at any point in a complete revolution indicates the presence of harmful foreign material. If re-washing the chamber fails to remove the obstruction, remove the throat plate and again wash the impeller chamber. In the event that this does not reveal or remove the trouble and it persists with the throat plate removed, return the unit to the depot for repair.

(3) Installation.-

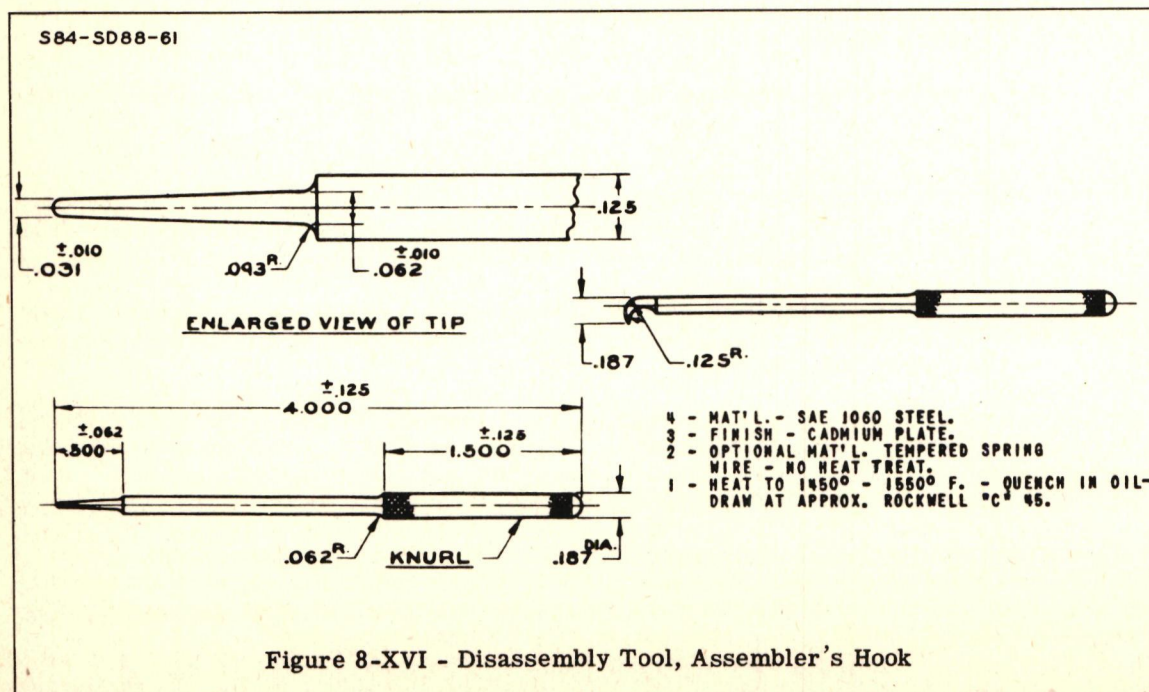
(a) Set a new gasket (TFA6307) in wet varnish, or use the old gasket which is still in place, if it is undamaged.

(b) Install the pump with the eight stud bolts and lock wire the bolts. The remainder of the installation is the reverse of the removal.

After the installation is complete, fill the tank with fuel and check for leaks and proper operation of the pump. The pump will develop approximately 16 pounds per square inch pressure at sea level and zero flow.

(4) Inspection.-

(a) 25-Hour.- Inspect for proper operation, leaks, and security of mounting and electric cable connection.



(b) 50-Hour.- Same as 25-hour inspection. Do not apply grease through the drain openings of the pump. No lubrication is required except for replacement of grease-sealed motor bearings when necessary.

In case the pump does not deliver sufficient pressure, check the voltage of the electrical current supply and inspect the brushes for full contact on the commutator. If this does not correct the pressure, remove the pump and inspect the inlet screen for foreign particles and the impeller to see that it turns freely.

The pump is provided with three drain line connections. A one-quarter inch outside diameter drain line is installed from the lowest drain openings as determined with the airplane on the ground. The open end of this line is directed into the slipstream so that a suction will be created, carrying away the fuel which leaks past the seal and serving to circulate fresh air through the motor for ventilation. If excessive leakage occurs out of the seal drain tube, the unit must be replaced.

f. Disassembly of Electric-Driven Fuel Pump, Thompson TFD 8000.- (Refer to fig. 7-XVI.)

(1) Take out screws (2) and remove screen (44) and throat (45).

(2) Remove cotter pin (6) by gripping it with side-cutting pliers and gently prying against impeller nut.

CAUTION: Excessive pulling will bend the shaft.

(3) Remove impeller nut. Use two narrow, sharp-pointed screwdrivers, prying against the housing. Bear equally on both screwdrivers so that shaft will not be bent. Remove seal spring (9).

(4) Pry out impeller key (22) by pinching with side cutting pliers.

(5) Remove shims (7), seal cup (10), seal cushion (11), and rotating fuel seal (12), using a tool similar to TFA 6064, illustrated in fig. 8-XVI.

CAUTION: The rotating seal may be easily scratched or chipped. The small brass shims (8) are installed back of the impeller to position it correctly with respect to the throat.

NOTE: Keep the shims with the parts from which they came, as they can probably be used again on reassembly.

(6) Sever the lock wire on seal nut (13) and remove it.

(7) Remove the stationary fuel seal (14), taking care not to scratch or chip the face.

(8) Take out seal gasket (15).

(9) Shaft slinger (16) is a press fit on the shaft and is not removed unless the motor is disassembled. If it is removed, a new part must be installed on assembly.

9. Fuel Selector Valve. (See fig. 9-XVI.)

a. Purpose in System.- The fuel selector valve is designed to permit a full flow of gasoline from one or more of the fuel tanks, at the selection of the pilot.

b. Location.-

(1) Valve.- Mounted on the lower left-side of the bulkhead which is located just aft the target approach doors (fig. 1-XVI).

(2) Control.- Mounted on a bracket on the floor of the pilot's cockpit, left and forward the control stick (fig. 1-XVI).

c. Description.- The valve is essentially a cluster of poppet valves, radiating from a common center. Valves are unseated by a cam which pivots on this same center (fig. 9-XVI). All valve ports are 3/4-inch, inside diameter. Appropriate markings on the dial, used in connection with the selector valve, indicate the valve is open and which fuel tank is serving the fuel system.

d. Operation.- The fuel selector valve is manually controlled by the pilot. Revolving the indicator to any one position on the dial opens the corresponding valve in the selector unit.

e. Removal and Installation.-

- (1) Drain all the tanks.
- (2) Drain all the lines ahead of the selector valve by opening the drain cock in the fuel strainer.
- (3) Loosen the clamps and remove the six hoses from the selector valve.
- (4) Protect the open ends of the hoses and the selector valve to keep out dirt and foreign matter.
- (5) Disconnect the fuel cock control from the selector valve.
- (6) Remove the three bolts holding the selector valve to the bulkhead.

f. Installation is essentially the reverse of removal, except that all connections should be checked for leaks. To assist in installation, a diagram that shows the position of the ports with respect to the tanks, has been placarded on the forward side of the bulkhead just aft the target approach door.

NOTE: The port corresponding to the "RESERVE" supply is not used, and will be plugged. See instructions immediately below.

g. Special Instructions.-

(1) Whenever one of the fuel tanks is not in use, it is desirable to plug the corresponding port in the selector valve. In such cases, it will be necessary to remove the poppet valve to prevent damage to the fuel selector. (A plug would prevent valve action and, as the cam swung around, it would jam the immobile valve.)

To remove the poppet valve, proceed as follows:

- (a) Remove the selector valve as described above.
- (b) Remove the 90-degree bend (AN842).
- (c) Remove the four screws holding the 3/4-inch port fitting and remove the fitting.
- (d) Remove the lock ring, being careful not to allow the springs and seat to fly out.
- (e) Remove the spring, spring seat, and valve assembly.

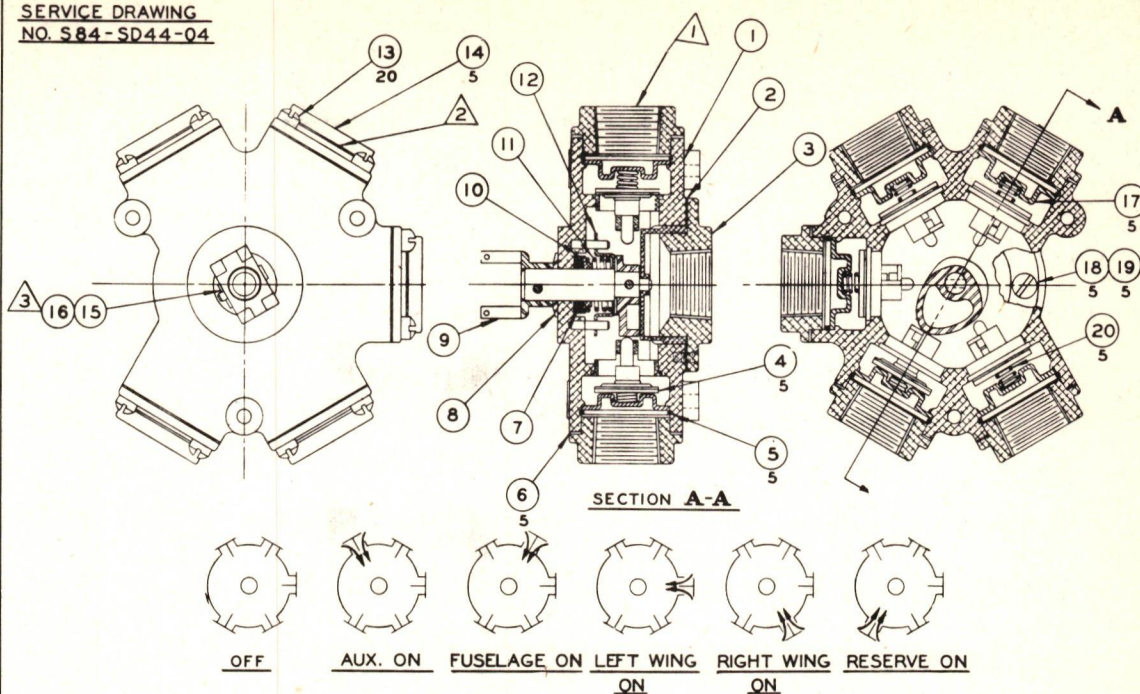
To install the poppet valve: Ascertain that the valve seat is smooth and clean and that there are no foreign particles on the parts to be assembled. The installation is essentially the reverse of the removal. Check for leaks when tanks are filled.

(2) Take care to insure that the selector valve opens the proper port, corresponding to the dial in the cockpit.

10. Oil Dilution System. (See fig. 1-XVI.)

When the A-25A Airplane is operating in climates where extremely low temperatures are encountered, the oil dilution system becomes an extremely necessary adjunct to the lubricating

SERVICE DRAWING
NO. S84-SD44-04



<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Body Assembly	93988
2	1	Gasket	93991
3	1	Cover	93992
4	5	Valve Assembly	1238107
5	5	Ring Lock	838136
6	5	Gasket	838134
7	1	Seal	37A4959
8	1	Washer	36A5465
9	1	Yoke	06759D
10	1	Retainer	37A4958
11	1	Spring	43860
12	1	Plate Index	93984
13	20	Screw	210517-208
14	5	Cover	83813
15	1	Pin, Flathead	AN392-21
16	1	Cotter Pin	AN-380-2-2
17	5	Spring Seat	103857
18	5	Flathead Screw	505-10-7
19	5	Lock Washer	No. 10 Shakeproof
20	5	Spring	103856

NOTES:

- ① Tapped 3/4-inch pipe - 6 holes.
- ② Lock wire required as shown.
- ③ Narrow slot in yoke must be in line with and adjacent slot in stem.
4. **WARNING:** To prevent damage to the valve, never operate with any port plugged without first removing poppet from that port.

(THIS DRAWING CONFORMS TO AERO SUPPLY MFG. CO. NO. 93940-B)

Figure 9-XVI - Fuel Tank Selector Valve

system. Its purpose is to facilitate engine starting by diluting a small portion of the engine oil with gasoline. This "thinned-out" oil more readily flows to and through the cold engine, providing lubrication which otherwise would be lacking.

Dilution of the oil is controlled by a switch mounted on a switch box in the pilot's cockpit. Closing this switch energizes a solenoid, opening a valve which forces gasoline, under pressure, into the oil inlet line. Opening the switch, closes the dilution valve and the process is stopped. In practice, a pilot, who anticipates cold weather, will dilute a portion of his oil by allowing the system to function for a short period, just before stopping his engine. Refer to T. O. No. 02-1-29 for oil dilution procedure and periods.

Besides the switch and dilution valve mentioned above, the system consists of two shut-off valves, one at the intake at the carburetor and the other at the outlet at the oil inlet line, and the necessary tubing and fittings (fig. 1-XVI). The shut-off valves should be kept closed and safetied during warm or hot weather. To prevent constant diluting of the oil, the oil dilution valve will be inspected according to the following:

a. At Each 25-Hour Period.-

- (1) Remove plug at bottom of valve.
- (2) Start the airplane engine.

DANGER - KEEP AWAY FROM PROPELLER.

(3) If gasoline leakage through plug is less than 10 drops a minute, re-install plug. The valve is satisfactory.

(4) If leakage is over ten drops per minute, re-install plug. Start the engine and then turn the oil dilution valve on and off for ten five-second periods. Stop engine and remove plug. Start engine and, if leakage is less than ten drops per minute, re-install plug. The valve is satisfactory. If leakage is still over ten drops per minute, proceed as follows:

(a) Using a steel rod, or a finger, push the end of plunger inward several times and then let it spring back. This will tend to produce better seating of the valve.

(b) Start the engine. If leakage is still over ten drops per minute, replace valve assembly with new valve, and forward the defective valve to the control depot with reparable parts tag. If leakage is under ten drops per minute, re-install plug.

11. Vapor Dilution System.

a. Purpose in the System.- The purpose of the system is to dilute the air entering the fuel tank with carbon dioxide to such a degree that there is not sufficient oxygen above the gasoline level to permit combustion.

b. Location of Units.- The carbon dioxide bottle (reservoir) is fastened to the forward side of the bulkhead just aft of the target approach door (fig. 1-XVI). An extension rod leads from the bottle upward through the floor of the pilot's cockpit, aft and right of the control stick, where a handwheel with a locking pin is located. A safety disc washer is installed in a port connected to the cylinder side of the reservoir outlet valve. A safety discharge line from this port leads to a red celluloid disc, mounted in the skin of the fuselage on the right side of the airplane, just above the leading edge of the wing. The system regulator valve is fastened on the aft side of the above mentioned bulkhead on the right side of the ship. The discharge valve is at the top center of the aft end of the fuselage fuel tank.

c. Operation.-

(1) Revolving the handwheel releases the carbon dioxide to the regulator valve. This unit allows a sufficient amount to flow to the discharge valve which, in turn, injects the gas into the fuselage tank.

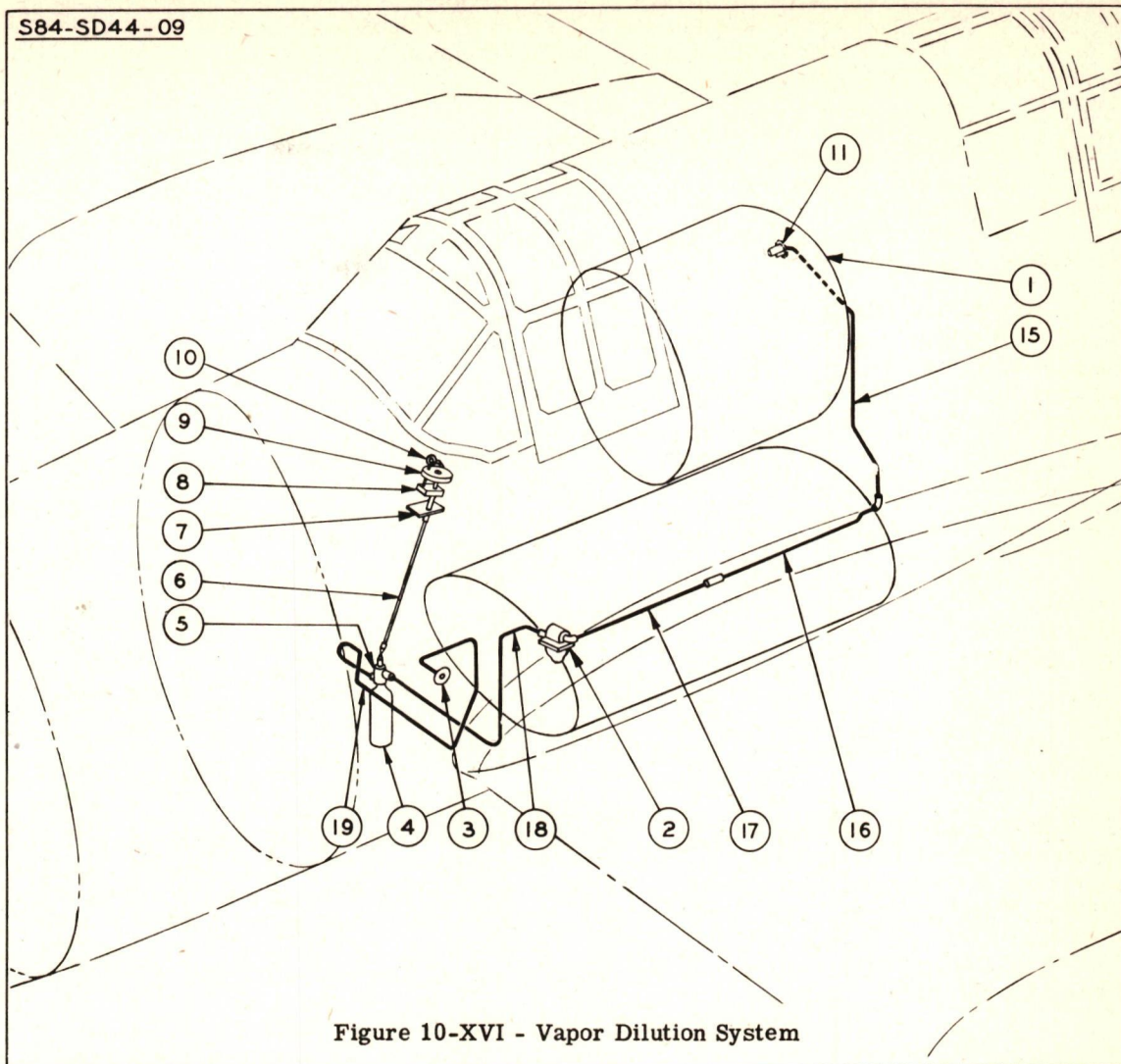


Figure 10-XVI - Vapor Dilution System

PARTS LIST

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1		Fuselage Fuel Tank (Ref.)	S84-SD44-02
2		Regulator (Ref.)	S84-SD79-01
3		Fire Extinguisher Discharge Fitting (Ref.)	S84-SD79-01
4		Cylinder Assembly (Ref.)	S84-SD79-01
5		Valve (Ref.)	S84-SD79-01
6	1	Control Rod	S84-44-519
7	1	Bracket Assembly	S84-44-551
8	1	Block Assembly	S84-44-520
9		H and Wheel (Ref.)	S84-SD79-01
10	1	Locking Pin Assembly	S84-44-526
11		Discharge Fitting (Ref.)	S84-SD79-01

LINE ASSEMBLIES - VAPOR DILUTION SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>
15	S84-44-504-5	1	Fuselage Fuel Tank to Elbow	1/4 x .035	45.38	52SO	AN819-4 AN819-4 AN818-4D AN818-4D
16	S84-44-504-3	1	Elbow to Bulkhead Fitting	1/4 x .035	34.38	52SO	AN819-4 AN819-4 AN818-4D AN818-4D
17	S84-44-504-7	1	Bulkhead Fitting to Pressure Regulator	1/4 x .035	25.88	52SO	AN819-4 AN819-4 AN818-4D AN818-4D
18	S84-44-504-1	1	Pressure Regulator to Cylinder Assembly	5/16 x .035	31.88	52SO	AN819-5 AN819-5 AN818-5D AN818-5D
19	S84-44-504-10	1	Cylinder Assembly to Vent from Out- side	1/4 x .035	62.00	52SO	20863 AN819-4 (W.Kidde Co.) AN818-4D

Airplanes 41-18774 through 41-18778 use tubing 1/4 x .042 instead of 1/4 x .035.

Airplanes 41-18774 through 41-188798 use AC811T sleeves instead of AN819 sleeves.

(2) The safety disc washer will rupture and discharge the cylinder when the pressure rises to an unsafe value due to excessive temperature. Rupture of the red indicator disk will indicate this condition has occurred.

d. Removal.-

(1) Carbon Dioxide Cylinder.- In order to remove this unit, proceed as follows:

- (a) Turn the cylinder valve off.
- (b) Remove the control rod by removing the cotter, washer, and pin.
- (c) Remove the sleeve nut coupling at the carbon dioxide cylinder on the cylinder to regulator line.
- (d) Remove the self-locking nut and bolt on the clamp on the carbon dioxide cylinder to prevent it from falling. Remove the cylinder.

(2) Regulator, Model V-4110.-

- (a) Turn the carbon dioxide cylinder valve off from the pilot's cockpit.
- (b) Remove the connections from the regulator which connect to the line from the carbon dioxide cylinder and the line to the fuselage fuel tank.
- (c) Remove the two bolts securing the regulator to bulkhead No. 35, being careful not to let the regulator fall.

e. Installation procedures of the carbon dioxide cylinder and the regulator are essentially the reverse of the removal. Safety all parts.

f. Repairs.-

(1) No repairs should be attempted on the carbon dioxide cylinder, fittings, or tubings. Some parts of the valves and regulator may be replaced.

(2) The red indicator disk must be replaced if found to be "blown." This is accomplished by removing the snap ring, inserting a new disc, and replacing the snap ring.



§84-SD44-25

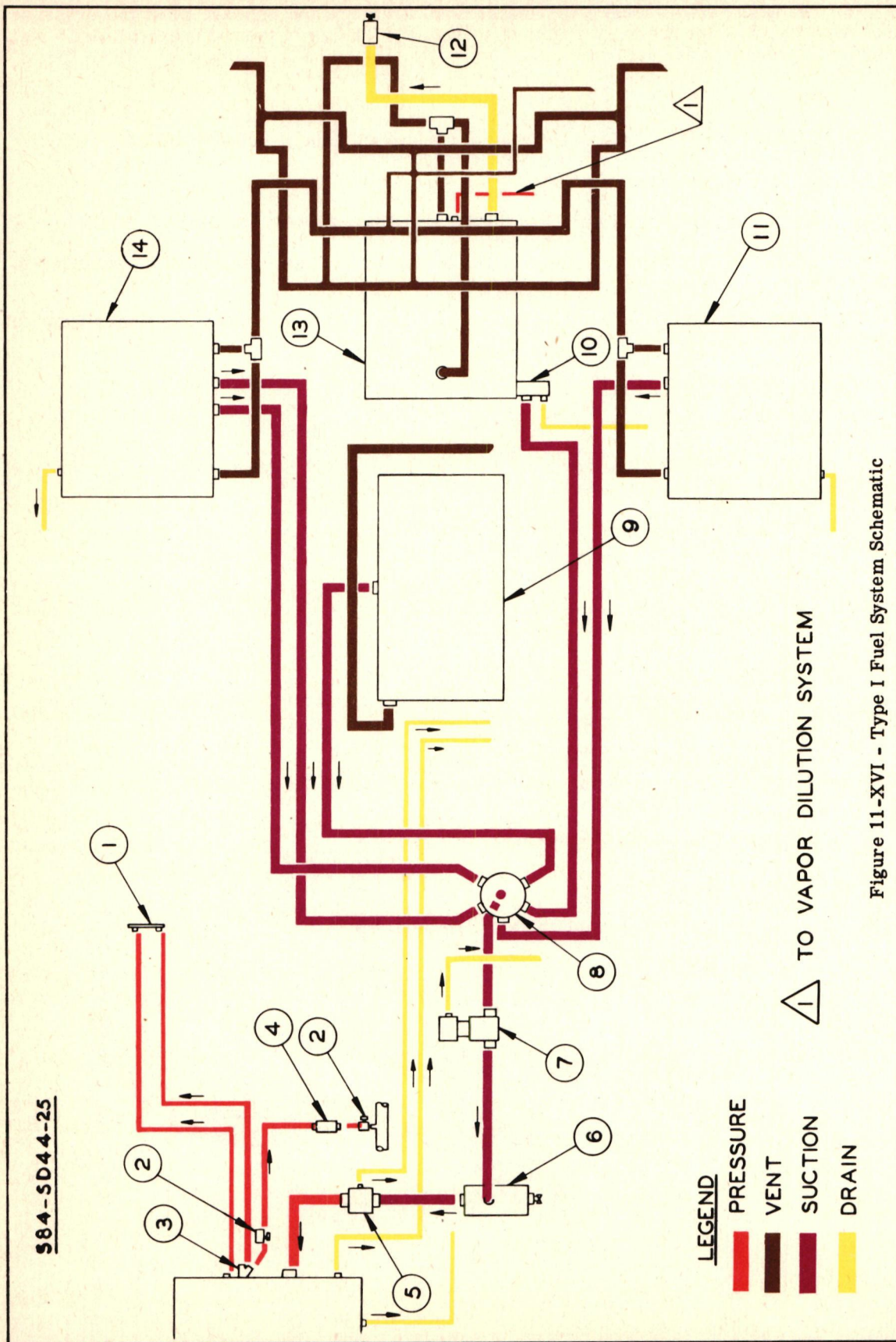


Figure 11-XVI - Type I Fuel System Schematic

PARTS LIST - FUEL SYSTEM SCHEMATIC - TYPE I

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Connector Panel	S84-44-546
2	2	Valve	NAF 1076-11
3	1	Fitting	AC37A-3528
4	1	Solenoid Dilution Valve	M441-M2 (Air Associates) *
5	1	Engine Fuel Pump	Navy Type H4E3
6	1	Fuel Strainer	63701 (Aero Supply)
7	1	Auxiliary Fuel Pump	2-E-608-A (Pesco)
8	1	Fuel Selector Valve	93940 (Aero Supply)
9	1	Auxiliary Fuel Tank	S84-45-502
10	1	Booster Pump	TFD 800 (Thompson)
11	1	Left Wing Fuel Tank	S84-45-508L
12	1	Plug Assembly	AN4043-2
13		Fuselage Fuel Tank	S84-44-508
14	1	Right Wing Fuel Tank	S84-45-508R

* Airplanes No. 41-18774 through 41-18848 use AC-37D - 621D

12. Carburetor and Priming System.

The carburetor and primer are discussed in section XV, paragraph j. The primer is built into the carburetor and is operated electrically.

13. Piping and Hose Connections.

All the hose used for conducting fuel from the tanks to the engine is of the one-inch inside-diameter self-sealing type.

No repairs can be made on these lines, clamps, or fittings. They must be replaced if damaged.

The vent and drain lines are 52SO aluminum alloy. The flexible hose connections are standard AN880 with standard clamps 250-D. These parts must be replaced if they are damaged or show signs of deterioration.

14. Strainers and Drains.

Throughout the fuel system, there are several strainers and drains. There are strainers and drains in each of the fuel tanks; there is a strainer located just ahead of the fire wall and at the carburetor fuel inlet.

The strainer ahead of the fire wall (fig. 1-XVI) is the main fuel strainer of the system. (Aero Supply Mfg. Co. No. 63701.) This unit may also be used as a drain. The fuel may be drained by removing the lock wire and opening the drain. The strainer may be removed after the fuel has been drained by removing the lock wire from the strainer clamp and loosening the clamp (23416 assembly).

When reassembling the strainer, do not forget to replace the gasket (23414) and lock wire. After this unit is re-installed, it must be checked for leaks with the fuel system under pressure, and all adjustments made to stop leaks.

There is a drain valve located at the lower right side of the supercharger rear section. The purpose of this drain is to remove any fuel or oil which may accumulate in the supercharger section. The operation of this drain valve is automatic.

Section XVII

OIL SYSTEM

1. General.

There are two designs of oil systems found in the A-25A Airplane. Both systems include an oil tank, an oil cooler with a rotary temperature control valve, an oil pressure gage, an oil temperature gage, oil dilution system, and the necessary lines, fittings, and drains.

The first of these two systems, which is arbitrarily designated as type "I," is built into airplanes No. 41-18774 to 41-18873 and airplanes 42-79663 to 42-79672, inclusive. Airplanes 42-79673 and up are equipped with the second type of oil system, which is known as the type "II" system, hereafter. The latter system is very similar to the first, except that the addition of a "hopper" to the reservoir of the second system, entailed a change in the design of the rotary temperature control valve and to the oil tank itself.

Fundamentally, the two systems are designed to furnish oil to the engine, in sufficient quantities within certain desirable temperature ranges. The normal oil flow is from the oil tank sump to the oil pump, located on the lower left-hand side of the engine accessory housing. After passing through the engine, the oil is pumped into the return line by the oil scavenger pump. It then flows through the return line to the rotary temperature control valve, which directs the oil flow through various channels, depending on the temperature of the oil when it reaches this point.

The oil flow eventually reaches the oil tank after the temperature control valve has caused it to bypass the radiator, or caused it to flow through the radiator (whichever was necessary) according to the temperature of the oil.

2. Oil Tank.

a. General Description.- The location of the oil tank, in both systems, is on the engine side of the fire wall. The tanks are located high enough on the fire wall to allow the force of gravity to assist in feeding the lubricant into the system. Attachment to the fire wall is accomplished with padded flexible steel straps, which pass around the tank and are secured with properly safetied turnbuckles. The tanks are constructed of 3S-1/2 H aluminum and are designed to withstand internal pressures of four pounds per square inch. Bulkheads, which are riveted to the shell, are built into the tanks and serve as baffles. The tanks of the two systems have a total volume of slightly more than 32 U. S. gallons (26.6 Imperial gallons). However, good practice dictates that the capacity should be limited to 25 U. S. gallons (20.8 Imperial gallons) so that a "foaming space" of better than seven gallons remains in the tank. The sump sediment space of each type of tank amounts to six-tenths of a gallon. (Incidentally, a petcock is installed on the left side of the sump of the type II tank to drain off the sediment.) The oil feeder lines of both the type I and type II tank lead from the bottom of the sump, but the oil return lines differ.

The type I oil tank has a return line at the top and the bottom, while the type II tank has a line to the top only. The bottom return line is eliminated from the type II tank so that all of the oil from the rotary temperature control valve is directed to the "hopper" which is built into this tank. The hopper itself is a cylindrical assembly whose lower end tapers down into a funnel-like shape. The funnel extends far enough into the sump to allow comparatively small quantities of new oil to flow into the feeder line, as long as ample quantities of used oil remain in the hopper. Fresh, unused oil is thus constantly available to the engine. This segregation of used oil from new insures that the older, used oil will be consumed by the engine first, thus eliminating oil changes which are very often wasteful and uneconomical.

The segregation of oil, allowed by the hopper, is also an important and necessary adjunct of the oil dilution system, which is more fully explained in section XVI which deals with that assembly.

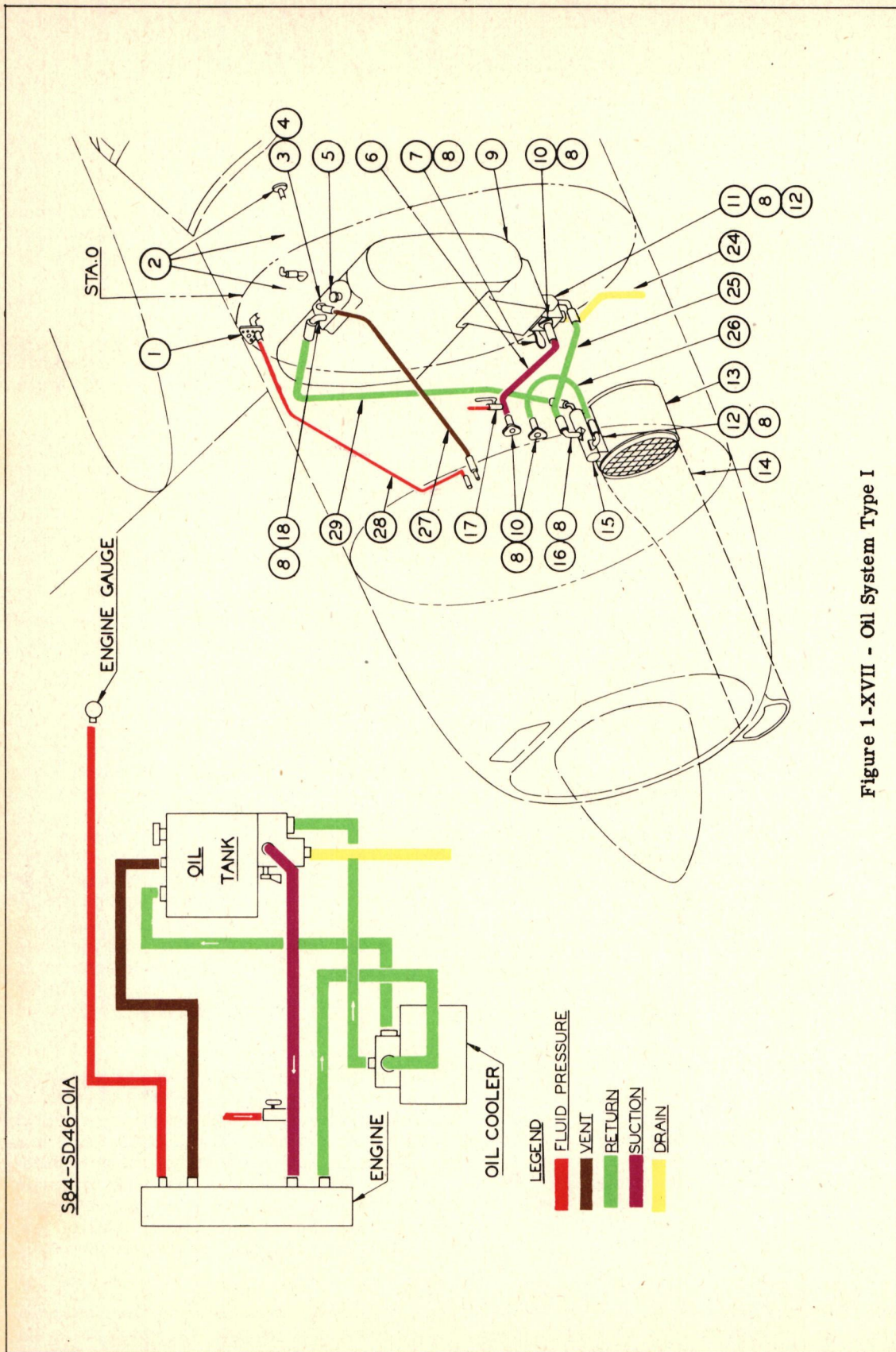


Figure 1-XVII - Oil System Type I

PARTS LIST - OIL SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part Number</u>
1		Connector Panel (Ref.)	See S84-SD44-02A
2		Engine Gage and Lines (Ref.)	See S84-SD61-01A
3	1	Elbow	S84-46-522
4	1	Gasket	S84-46-523
5	1	Filler Cap Assembly	S84-47-515 *
6	1	Weld Assembly	S84-46-541
7	1	Drain Valve	Parker Appliance Co. 10-341-33
8	8	Gasket	S84-46-539
9	1	Oil Tank Assembly	S84-47-501
10	3	Fitting	S84-46-037
11	1	Check Valve	Pratt & Whitney B-24989
12	2	Fitting	S84-46-527
13	1	Oil Temperature Regulator Assembly	Harrison Radiator Co. 8504226 **
14		Duct Assembly (Ref.)	S84-28-501-83
15	1	Rotary Valve Assembly	Harrison Radiator Co. 8503642 **
16	1	Fitting	S84-46-528
17		Oil Dilution Line (Ref.)	See S84-SD44-02A
18	1	Elbow	S84-46-538

* Filler cap assembly No. S84-47-515 is a part of oil tank assembly No. S84-47-501.

** Oil temperature regulator No. 8504226, plus rotary valve assembly No. 8503642 make up "Harrison Radiator Co." Oil temperature regulator and valve assembly No. 8503641

Effective airplanes No. 41-18774 through 41-18873 and No. 42-79663 through 42-79672.

LINE ASSEMBLIES - OIL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>
24	S84-46-501-16	1	Tank Drain to Outside	1 O.D. x .049	17.00	52SO Alum.Al.
25	S84-46-501-13	1	Cooler to Tank	1-1/4 O.D.x.049	16.00	52SO Alum.Al.
26	S84-46-501-12	1	Engine to Cooler	1-1/4 O.D.x.049	29.00	52SO Alum.Al.
27	S84-46-501-15	1	Crank Case Vent to Tank	3/4 O.D. x .049	33.50	52SO Alum.Al.
28	S84-46-501-17	1	Oil Pressure Line from Engine to Fire Wall Contractor Panel	1/4 O.D. x .032	43.25	52SO Alum.Al.
29	S84-46-501-14	1	Cooler to Tank	1-1/4 x .049	55.00	52SO Alum.Al.

The installation of the hopper made necessary the removal of the filler neck from the top of the tank (where it is found in the type I system) to the front of the tank. Obviously, this was done to prevent new oil from being poured into the hopper. However, another advantage to this position of the filler neck is that it makes it impossible to service the tank with more oil than is desirable. It is necessary, with the filler neck at the top, to use a sounding rod to determine that the proper quantity of oil is in the tank. Filling to overflowing, will accomplish this same purpose in the type II tank. The installation of the hopper required the removal of the strainer, which was mounted directly below the filler neck of the type I tank.

S84-SD46-16

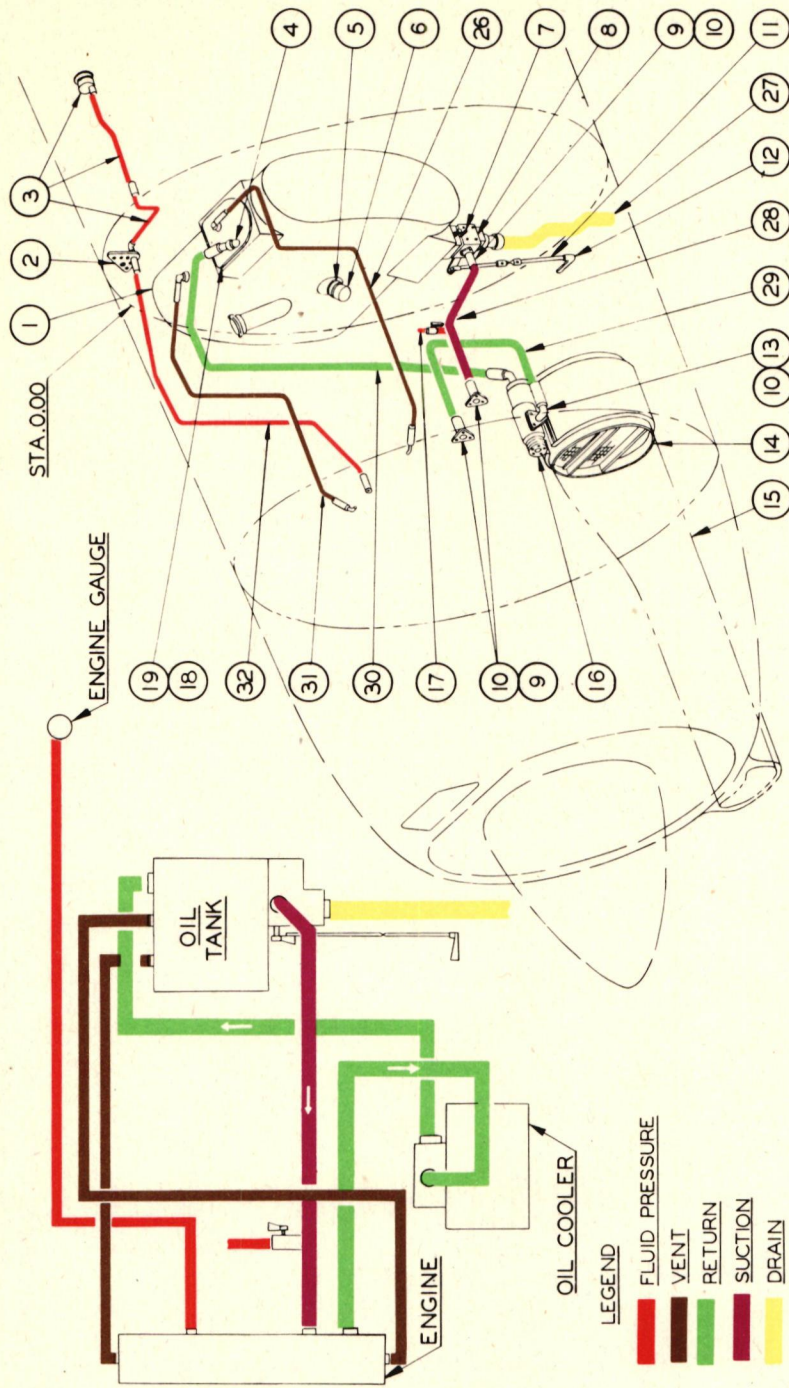


Figure 2-XVII - Oil System Type II

PARTS LIST - OIL SYSTEM

<u>Ref. No.</u>	<u>Quantity</u>	<u>Item</u>	<u>Part No.</u>
1	1	Tank Assembly	S84-431-1001
2		Connector Panel (Ref.)	S84-SD44-02A
3		Engine Gage and Lines (Ref.)	S84-SD61-01A
4	1	Cover	S84-431-1010
5	1	Heater Adapter Assembly	S84-431-1017 *
6		Westinghouse Immersion Oil Heater (Ref.)	S No. 1214510 *
7	1	Drain Cock	AAF770-2
8	1	Drain Valve	S84-431-1020
9	3	Fitting	S84-46-437
10	4	Gasket	S84-46-539
11	1	Oil Tank Drain Valve Control Assembly	S84-429-1012
12	1	Oil Drain Handle	S84-429-1014
13	1	Fitting	S84-46-527
14	1	Oil Temperature Regulator Assembly	8505070 **
15		Duct Assembly (Ref.)	S84-28-501-83
16	1	Rotary Valve Assembly	8505071 **
17		Fuel Line for Oil Dilution (Ref.)	S84-SD44-02A
18	1	Oil Tank Ring	S84-431-1012
19	1	Gasket	S84-431-1011

Effective airplanes No. 42-79673 and up.

* Remove from airplane No. 42-79823 and up.

** Oil temperature regulator assembly No. 8505070 plus rotary valve assembly No. 8505071 make up "Harrison Radiator Co." Oil temperature and valve assembly No. 8505072.

LINE ASSEMBLIES - OIL SYSTEM

<u>Ref.</u>	<u>Part No.</u>	<u>Quan.</u>	<u>Location</u>	<u>Size</u>	<u>Stock Lgth.</u>	<u>Material</u>	<u>End Fittings</u>	
26	S84-429-1017-4	1	Crankcase Vent (Left-Hand Side)	1/2 x .049	56.00	52SO WW-T-787	Beaded Beaded	Beaded Beaded
27	S84-429-1017-5	1	Oil Tank Drain	1-1/2 x .049	18.00	52SO WW-T-787	Beaded Beaded	Beaded Beaded
28	S84-432-1028	1	Tank to Engine	1-1/4 x .049	16.50	52SO WW-T-787	Beaded Beaded	Beaded Beaded
29	S84-429-1017-2	1	Engine to Oil Cooler	1-1/4 x .049	31.00	52SO WW-T-787	Beaded Beaded	Beaded Beaded
30	S84-429-1017-7	1	Oil Cooler to Oil Tank	1-1/4 x .049	64.00	52SO WW-T-787	Beaded Beaded	Beaded Beaded
31	S84-429-1017-3	1	Crankcase Vent (Right-Hand Side)	1/2 x .049	47.00	52SO WW-T-787	Beaded Beaded	Beaded Beaded
32	S84-429-1017-6	1	Oil Pressure	1/4 x .035	49.25	52SO WW-T-787	Beaded Beaded	Beaded Beaded

The oil tanks of the two systems are vented to the crankcase of the engine. The type I system has one vent line from the top of the tank. The type II system has two vent lines. The two lines are attached in such a manner that the tank will remain vented in any flight attitude within the limits of a 15-degree tilt, a 75-degree climb, or a 90-degree dive.

b. Removal. -

- (1) Remove engine compartment cowling.
- (2) Drain all oil from the tank by opening the drain valve and removing the drain plug.
- (3) After the oil is drained, close the drain valve and replace the plug.
- (4) Remove all bonding connections.
- (5) Disconnect the vent lines and oil lines.
- (6) Remove the drain line.
- (7) Sever the lock wire from the turnbuckles and loosen them.
- (8) Remove the tank from the airplane.

c. Maintenance. - The oil tank will be removed and cleaned at every fourth engine change, and at all engine changes made necessary by internal engine failures. The tank will be cleaned with hot kerosene, Specification No. VV-K-211, by removing the drain plug and flushing thoroughly. If steam cleaning equipment is available, this method may also be used.

d. The installation procedure is essentially the reverse of the removal. However, the following precautions should be observed:

- (1) Ascertain that all cradle support pads are properly replaced.
- (2) Be sure the turnbuckles are securely tightened and safetied.
- (3) Be sure the drain valve is closed and the drain plug is secure. Replace all lock wire.
- (4) Replace all bonding wire.
- (5) Hose connections should be leak-tight, but not excessively tightened.

3. Rotary Temperature Control Valve and Radiator.

a. Description. - The two types of rotary valves are readily distinguishable. The type I valve has two outlets, one from the aft end and one from the top of the valve cylinder. The type II valve has but one outlet, leading from the aft end. Since the operation of both valves is similar, and since detailed information concerning the type II valve is not yet available, the following explanation of the operation of the type I valve will be sufficient to furnish an understanding of the principles of operation of both types.

The entire type I assembly - oil cooler and valve - is designated as Harrison No. 8503641, model NCV-7. The cooler alone is identified by Harrison No. 8504226, model NOC-120-9B; the valve alone as Harrison No. 8503642, model NR-461B.

The assembly is suspended from the forward end of the two lower members of the engine mount by a bracket assembly. Ventilation of the radiator, with its attendant cooling effect, is provided by a duct whose forward opening is located in the bottom portion of the speed ring. The mouth of the duct is known as an air scoop. Air, leaving the radiator, exits through two flaps which are installed in the lowest part of the engine accessory cowling. These flaps are mechanically operated, being interconnected with the cowl flap mechanism.

The radiator is the cartridge-type, cylindrically shaped. A warm-up jacket surrounds its outside diameter. Suitable baffles are built into the case and augment its rigidity.

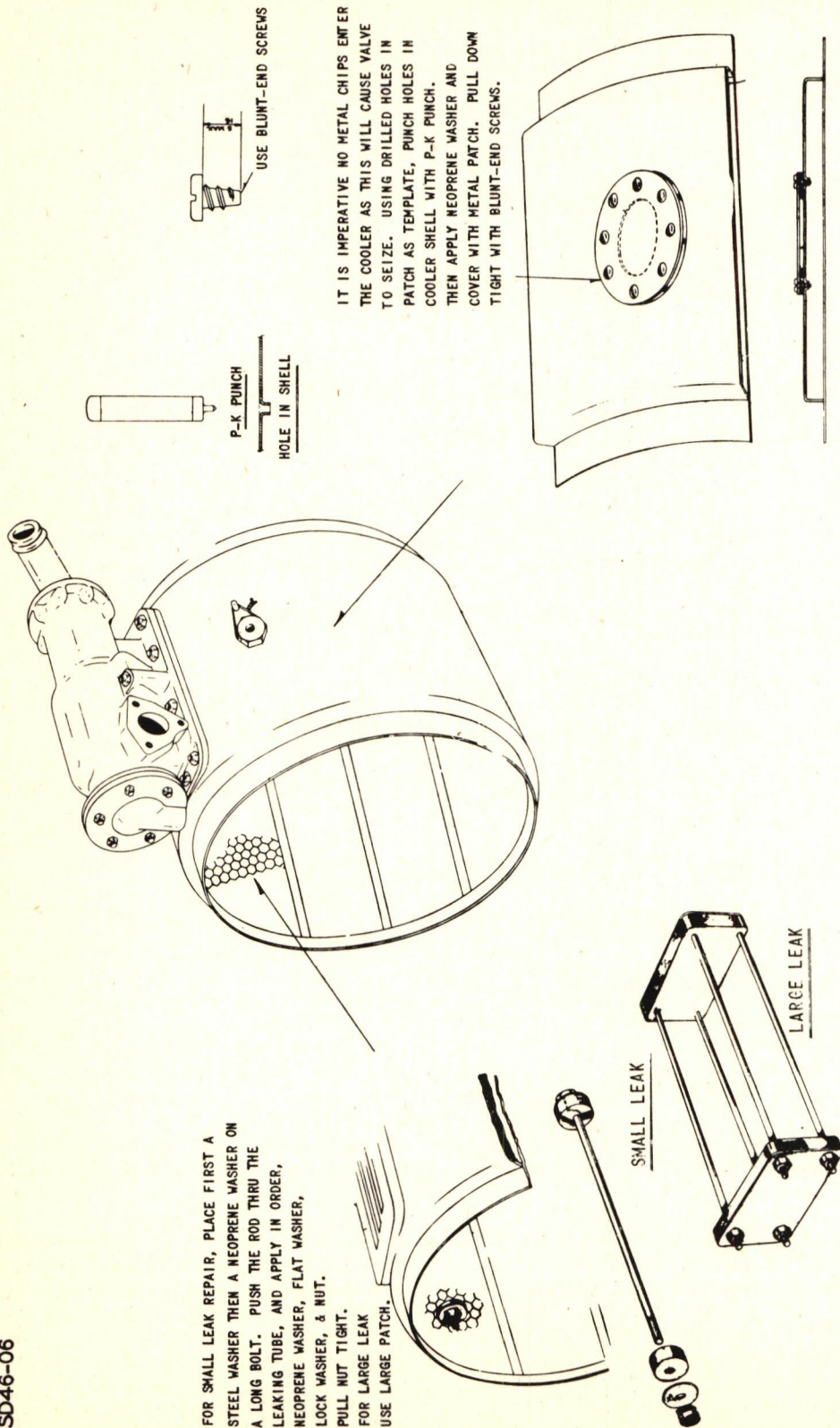


Figure 3-XVII - Harrison Oil Radiators, Temporary Repairs

The temperature control valve consists of a bi-metal helix which responds to changes in oil temperature and revolves the rotary valve barrel to close or open certain ports and thus direct the air flow. A relief valve is incorporated and so adjusted that it allows the oil to bypass if the pressure should reach 30 pounds per square inch, due to restrictions in the cooler.

The barrel is so designed that, as it rotates, its various positions will cause the following flows of oil at the temperatures indicated.

<u>Temperature</u>	<u>Position of Barrel</u>	<u>Oil Flow</u>
(1) Below 21° C (70° F)	(a) Bypassing port open and all other ports closed.	1. To oil tank sump.
(2) 21° C to 39° C (70° F to 102° F)	(b) Bypass port begins to close and cooler inlet and warm-up jacket inlet beginning to open.	1. To oil tank sump and to top of tank.
(3) 40° C to 59° C (104° F to 138° F)	(c) Bypass completely closed and inlet to cooler and jacket completely open.	1. To top of tank.
(4) 60° C to 79° C (140° F to 174° F)	(d) Jacket port is starting to close, while the core inlet port stays open. Cooler core outlet port beginning to open.	1. To top of tank.
(5) 80° C (176° F)	(e) Jacket port is completely closed and the cooler inlet port and outlet port is completely open.	1. To top of tank.

Normally, this highest temperature will be maintained after the engine has been warmed up.

b. Removal. - The entire assembly can be removed from the airplane by following the following procedure:

- (1) Disconnect cowl flap control and remove cowling.
- (2) Drain all the oil from the system by removing the drain plug at the bottom of the radiator.
- (3) Disconnect all hose connections.
- (4) Unfasten all bonding wire.
- (5) Remove bolts holding the radiator to the brackets.
- (6) Remove the entire assembly from the airship.

NOTE: If desired, the valve can be disassembled from the radiator by removing the attaching bolts.

c. Maintenance and Repair. - The assembly will be removed in the event of an engine change resulting from internal engine failure. The parts will be tagged with a reparable parts tag, Form No. 50, bearing the notation, "Removed because of internal engine failure," and forwarded to depot.

Leaking radiators may be temporarily repaired by using long through-bolts, metal washers, and neoprene washers as illustrated in fig. 3-XVII.

d. Installation. - The installation of the assembly is essentially the reverse of the removal.

e. Service Trouble and Remedies.

<u>Trouble</u>	<u>Cause</u>	<u>Remedy</u>
(1) Oil overheating.	(a) Plugged air passage.	<u>1.</u> Clean foreign matter from tubes.
	(b) Regulator needs cleaning.	<u>2.</u> Return to depot.
	(c) Valve not functioning correctly.	<u>3.</u> Return to depot.
(2) Link in core tube.	(a) Collapsed tube caused by excessive pressure.	<u>1.</u> Remove and return to depot.
(3) Leak in core face at juncture of core and shell.	(a) Overtightening of mounting clamps.	<u>1.</u> Return to depot.
(4) Relief valve inoperative.	(a) Leakage past valve.	<u>1.</u> Return entire rotary valve to depot.

4. Oil Pressure and Oil Temperature Gage.

The line leading to the oil pressure gage portion of the engine gage unit begins at a point between the right magneto and the vent line on the engine accessory housing. Thus the reading is taken at a point beyond the oil pump and screen.

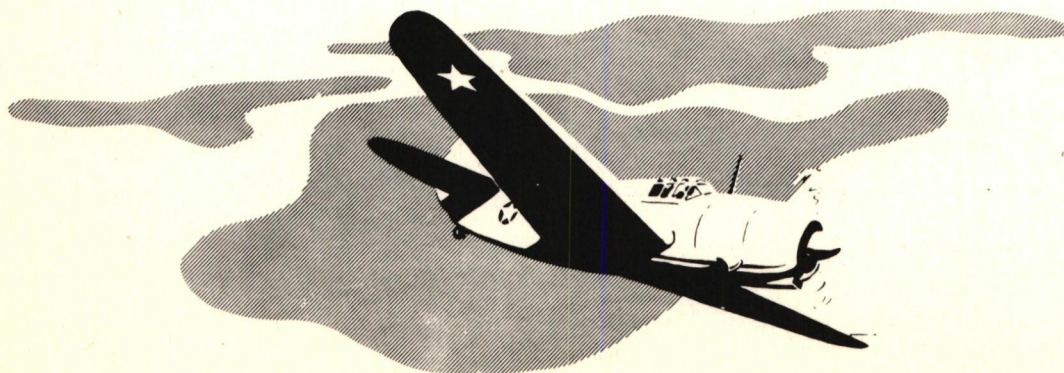
The oil temperature gage (also a portion of the engine gage unit) takes its reading from a point in the accessory housing in the vicinity of the inlet part.

Section X, dealing with instruments, gives a more detailed description on the operation and maintenance of these units.

5. Oil Dilution System.

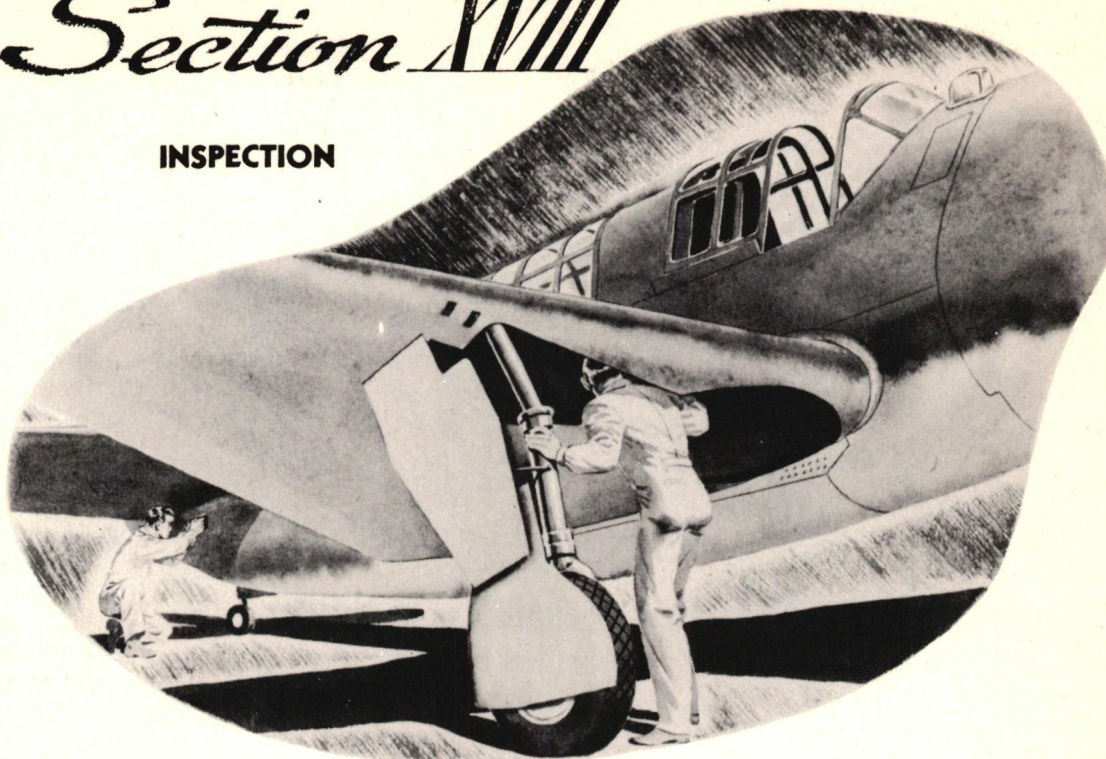
Refer to section XVI, fuel system, for a complete description of the function of the oil dilution system. That section, plus the remarks made above concerning the hopper, will give a complete explanation of this system.

One important point may be added. Most of the diluted oil will be stored in the hopper of the tank and thus will be the first oil to be fed into the system when the engine is again operated. This leads to the conclusion that the period, during which oil is being diluted, should be limited to the length of time necessary to dilute only that amount of oil which will fill the hopper of the tank and the system (usually about four minutes). Further dilution is superfluous and unnecessary, and may damage the engine.



Section XVIII

INSPECTION



1. General.

The Maintenance Inspection Record, Form No. 41B, is used as a guide in the arrangement of the parts of this section. The various "Daily," "25-Hour," "50-Hour," etc., Inspection Procedures are all grouped under applicable titles, which are arranged to correspond with the numbering of the columns of Form 41B. The following index may be used as a ready reference, which will aid in quickly locating the inspection procedures of the many components of the airplane:

<u>Column No.</u> <u>(Form 41B)</u>	<u>Title</u>	<u>Part No.</u>	<u>Page No.</u>
10	Preflight Inspection	2.	2
20	Engine Controls	3.	7
21	Engine Instruments	4.	7
22	Ignition and Electrical	5.	8
23	Fuel System	6.	10
24	Oil System	7.	12
25	Cooling System	8.	12
26	Valves	9.	13
27	Manifolds and Superchargers	10.	13
28	Propeller	11.	13
29	Power Plant, General	12.	17
31	Cockpit and Cabins	13.	20
32	Flight Control Mechanism	14.	20
33	Movable Surfaces	15.	21
34	Fixed Surfaces	16.	22
35	Fuel Tank	17.	22
36	Tail Gear	18.	22
37	Landing Gear	19.	23
38	Wheels and Brakes	20.	24
39	Hydraulic System	21.	25

<u>Column No.</u> <u>(Form 41B)</u>	<u>Title</u>	<u>Part No.</u>	<u>Page No.</u>
40	Fuselage	22.	26
42	Night Flying Equipment	23.	26
43	Miscellaneous, Airplane, General	24.	26
44	Navigation Instruments	25.	26
46	Battery	26.	28

Columns of Form 41B which are not applicable to the A-25A Airplane are not listed above. Columns 19 and 30 are omitted because - as stated in section XX - notations in column 19 indicate that all the inspections of columns 20 to 29 have been completed. Similarly, column 30 encompasses all of the separate items listed in columns 31 to 46.

It will be noted that all of the Inspection Procedures following are grouped under their applicable time periods; and it should be understood that procedures listed under "Daily" and "25-Hour" are always performed during the "50-Hour" inspection, also. In the same way the "100-Hour" inspection will include all of the operations of the "Daily," "25-Hour" and "50-Hour" inspections.

2. Column 10 - Preflight Inspection.

a. Before Starting Engines.-

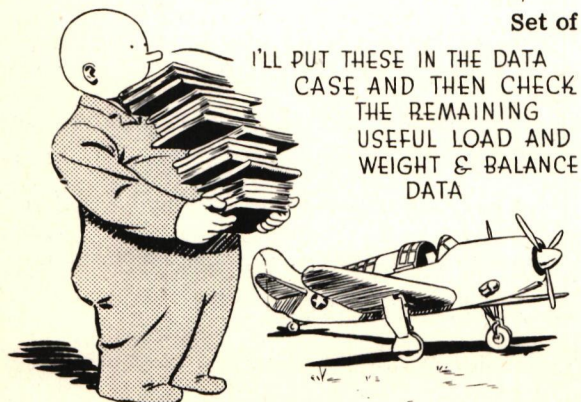
(1) Examine the Airplane Flight Record, Forms 1 and 1A, for completeness. If incomplete, make the necessary entries. Note routine inspections which are due and, if possible, make them. Otherwise, enter the proper symbols to indicate their omission. Be sure that an "Exceptional Release" is obtained before the airplane is flown, if a red symbol is notated in the "Status Today" space.

(2) Check the contents of the Aircraft Data Case. To be complete, it should contain the following publications:

<u>Publication No.</u>	<u>Title</u>
T. O. No. 00-20A	The Visual Inspection System for Airplanes.
T. O. No. 00-20A-2	Airplane Maintenance Instructions Forms.
T. O. No. 01-1-40	Weight and Balance Data Book.
T. O. No. 01-1-46	Winterization Check List Data Book.
T. O. No. 01-1-67	Handbook of Arctic Operations.
T. O. No. 01-1-78	Replacement of Detonator Circuit Fuse in Radio Set SCR-535.
T. O. No. 01-25AA-1	Handbook of Flight Operating Instructions, A-25A Airplane. (Curtiss-Wright Service Engineering Publication No. 4 will be furnished until Technical Order is available.)
T. O. No. 01-25AA-2	Handbook of Erection and Maintenance Instructions, A-25A Airplane. (SB2C-1 Erection and Maintenance Handbook with A-25A Addenda will be furnished until A-25A Publication or T. O. is available.)
T. O. No. 01-25AA-3	Handbook of Structural Repair Instructions, A-25A Airplane.
T. O. No. 01-25AA-4	Parts Catalog for the A-25A Airplane.

<u>Publication No.</u>	<u>Title</u>
T. O. No. 01-25AA-5	Handbook of Arctic Operation Instructions, A-25A Airplane. (Effective on Airplanes No. 42-79673 and up.)
T. O. No. 02-35-1	Table of Limits, Wright Engines.
T. O. No. 02-35HB-1	Operation Instructions, R-2600-8 Engine.
T. O. No. 02-35HB-2	Service Instructions, R-2600-8 Engine.
T. O. No. 02-35HB-3	Overhaul Instructions, R-2600-8 Engine.
T. O. No. 02-35HB-4B	Parts Catalog, R-2600-8 Engine.
T. O. No. 03-20B-1	Handbook of Instructions with Parts Catalog, Curtiss Electric Propellers.
T. O. No. 03-20B-2	Preliminary Handbook of instructions with Parts Catalog, Governor Control System, Curtiss Electric Propellers.
T. O. No. 03-20B-3	Operation Instructions for Curtiss Controllable Propellers.
Bulletin No. 65	Curtiss Electric Propeller Installation Instructions.
T. O. No. 08-5-1	Shielding and Bonding of Aircraft.
T. O. No. 08-5-2	Installation, Operation, Maintenance, and Inspection of Aircraft Radio Equipment.
T. O. No. 08-15-1	AAF Radio Facility Charts.
T. O. No. 08-15-1A	AAF Radio Facility Chart (Alaska Supplement).
T. O. No. 08-15-2	AAF Radio Data and Aids to Airways Flying.
T. O. No. 08-15-3	AAF Instrument Approach Procedures.
T. O. No. 11-1-12	Sealing Gun Blast Tube and Ejection Chute Openings.
T. O. No. 11-1-13	Handbook of Instruction, Caliber .50 Hydraulic Gun Charger.
T. O. No. 11-1-14	Handbook of Instruction, Hydraulic Gun Charger Control Valve.
T. O. No. 11-1-24	Use of Boresight Targets and Boresighting Procedure, Caliber .50 Guns.
T. O. No. 11-1-28	Cleaning, Lubrication, and Maintenance of Caliber .50 Aircraft Machine Guns.
T. O. No. 11-1-30	Description and Adjustment of Gun Firing Solenoids.
T. O. No. 11-1-38	Gun, Ammunition, and Bomb Capacities for Airplanes.
T. O. No. 11-15-1	Type AN-M8 Pyrotechnic Pistol.
T. O. No. 11-15-9	M-2 Pyrotechnic Pistols, Precautions in Use.
T. O. No. 11-25-2	Bomb Arming Wire and Swivel Loop.

<u>Publication No.</u>	<u>Title</u>
T. O. No. 11-25-3	Safety Precautions When Releasing Bombs.
T. O. No. 11-25-8	Armor Piercing, 1400-pound, M-63 Bomb.
T. O. No. 11-25-11	Methods of Arming Bombs.
T. O. No. 11-25-12	Minimum Altitude of Release of Bombs and Prearming of Fuses.
T. O. No. 11-35-5	Installation, Inspection, and Use, N-2, N-2A, N-3, N-3A, and N-3B Gun Sights.
T. O. No. 11-35-8	Light and Moisture Proofing of Gun Sights, N-2A, N-3, and N-3A.
T. O. No. 11-35-14	Protection of N-Series Gun Sights from Excessive Sunlight.
SEP No. 7	Boresighting Instructions for the A-25A Airplane, (Delete this item when T. O. No. 01-25AA-2 is available.)
SEP. No. 8	Booklet of Electric Wiring Diagrams.
SNL A-38	Standard Nomenclature List, Caliber .50 Aircraft Machine Gun.
TM 9-1225	Technical Manual, Ordnance Maintenance, Browning Machine Gun, Caliber .50, All Types.
TM 9-1980	Technical Manual, Bombs for Aircraft.
Form 1 and 1A	Flight Report Booklet.
Form 60A	Technical Order Compliance Record, Airplane.
Form 60B	Technical Instruction Compliance Record, Engine.
Form 61	Propeller Historical Record.
Form 263A	Aircraft Checker's Reports.
	Handbook of Instructions for Radio Set, Model SCR-274-N (Handbook must match equipment installed).
	Set of Miscellaneous Instrument Instructions.



NOTE: These orders and the current supplements and amendments thereto will remain with the aircraft at all times, and will be kept in the Aircraft Data Case, when not being used for reference purposes. At each 50-hour inspection of aircraft, the publications in the data case will be checked against T. O. No. 00-1 to determine whether the latest issues are on hand. Check case for security of cover fastenings to prevent spilling of contents. Make sure the baggage case is securely closed.

(3) See that the windshield and windows are clean.

(4) Check for quantities of fuel and oil in the tanks and enter the quantities on the Airplane Flight Report, Form 1A.

NOTE: This check must be made on the day the airplane is flown, previous to the first flight of the day. Checks made on a previous day cannot be considered part of the preflight inspection prescribed by these instructions.

(5) See that the fuel and oil tank caps are properly secured.

(6) See that all cowling is properly fastened.

(7) Check for security of fastening of all inspection doors.

(8) Ascertain that all flight controls work freely.

(9) Look for loose objects in the cockpit that may interfere with the operation of controls.

(10) Inspect landing gear and tail wheel assembly for damage and obvious defects. Check for proper strut extension and tire inflation. Refer to section V for tire inflation instructions. Ascertain that "up-latch" mechanism is in vertical position.

(11) Make sure ignition switches are "OFF" and then inspect propeller blades for nicks, scratches, looseness, etc.

(12) Inspect wings, ailerons, flaps, stabilizers, elevators, and rudder for damage or obvious defects.

(13) Check for proper level of fluid in hydraulic fluid reservoir. Fill if necessary, using oil, Specification No. AN-VV-O-366a as specified on fig. 1-XIX.

(14) If extra baggage or ballast is to be carried, make certain that it is securely fastened in place.

(15) Turn fuel valve one complete revolution to determine that it turns freely; set by "click and feel." Should any pronounced binding be indicated, determine the cause, and make the necessary repairs or replacements.

CAUTION: Whenever fuel cock controls are disconnected or fuel cock assemblies are removed or replaced, the reassembly of parts must be carefully checked to insure that the valve ports open to the tank positions indicated by the control-handle pointer.

NOTE: The pilot and other personnel responsible for the correct operation of this engine should study and be familiar with the operation of the fuel system. Fuel system failures and forced landing during the operation of aircraft, will unquestionably result if there is lack of knowledge on the part of the pilot regarding the operating characteristics of the fuel system, and the proper operations to be performed to insure its normal functioning. (See fig. 1-XVI.)

(16) Check all instruments for proper pointer position, broken or loose cover glass, or other visible defects. Clean all instrument cover glasses with a clean cloth.

(17) Check shock proof instrument panel for safety.

(18) Set altimeter to station altitude, or as directed by pilot.

(19) Set rate of climb indicator to "ZERO," and tap instrument to insure that hand is properly set.

(20) Check all lights: instrument, compartment, trouble, landing, running, and position lamps. Replace any defective lamps or fuses found.

(21) See that the clock is wound, running, and correct according to operations' office time.

(22) Remove protection cover from air-speed tube and see that the tube is clean and free from any obstruction. Check functioning of heater unit. Air-speed tubes are designed to operate satisfactorily under all operating conditions including those in which rain and ice-forming tendencies are encountered. Snow and ice are melted by the heating element. The resultant water and rain are prevented from entering the connecting tubing by drain traps. An accessible drain plug is incorporated in the lowest point of each system of connected tubing, to remove water which may have entered the connecting tubing as well as water which may have condensed therein. See that the pointer on the indicator indicates "ZERO" or the value of the wind velocity component in direction of aircraft heading.

b. During Engine Warm-up.- During this period of the Preflight Inspection, certain precautions should be observed. Before starting the engine, see that the wheels of the airplane are blocked. Also before starting, the propeller should be pulled by hand through several revolutions to clear the combustion chambers (See section XIII). Warm-up test periods should be as brief as possible to prevent excessive wear on moving parts and the engine should not be run with the control surfaces locked. Instructions for starting the engine are given in section XIII. Do not operate landing gear valves.

Airplane engines will always be warmed up on the ground until proper lubrication and engine operation for the take-off and flight are assured. During the warm-up period, the engine rpm will not be permitted to exceed one-half of the maximum permissible ground rpm until after the engine maintains, without fluctuations, at least two thirds of the minimum full power oil pressure specified, and the oil temperature gage shows a definite increase in oil temperature, indicating that oil is circulating properly. When these conditions are obtained, with mixture and propeller controls set for take-off, engine rpm may be increased to check engine and engine instruments for proper operation. Maximum permissible ground rpm will not be maintained for periods in excess of twenty to thirty seconds. The airplane should be nosed into the wind during the warm-up.

(1) Check for proper operation of engine instruments and note whether indications are consistent with the stage of the warm-up. There should be no excessive pointer oscillation.

(2) Check the volt-ammeter to see that the generator is charging properly (28.5 volts) and that the voltage regulator is functioning properly.

(3) Check operation of fuel quantity gage.

(4) Check functioning of manifold pressure gage.

(5) Check vacuum pumps. Vacuum should be four inches of mercury.

(6) Check operation of carburetor air heater.

(7) Check operation of controllable propeller.

(8) Ignition switches will be tested as follows:

With the engine running at about one-third throttle, turn the engine switch to the "OFF" position. If the engine does not entirely cease firing, defective functioning of the switch or its connections, most likely the ground connection, is indicated. For this test, the engine must not be excessively hot, and the period during which the switch is "OFF" must be brief so that the engine does not slow down too much.

WARNING: If the engine does not cease firing when the switch is placed in the "OFF" position, it will be necessary to stop the engine by "turning off the gas." AFTER THE ENGINE STOPS DO NOT TOUCH THE PROPELLER UNTIL THE DIFFICULTY HAS BEEN FOUND AND CORRECTED, AS THE ENGINE MIGHT "KICK OVER," THE PROPELLER CAUSING DEATH OR SERIOUS INJURY.

(9) The required fuel pressure must be obtained from each supply. The fuel selector valve must turn readily, and the position of the indicator in the fuel selector control must correspond with the setting indicated at the valve itself.

(10) Make visual inspection of all installed radio equipment for general condition. Make operating check of all units. Inspect fixed antenna system for condition and see that wires are taut. Clean dirt and carbon from insulators.

NOTE: Installed radio transmitters will not be operated (dynamotors running), if any point of the antenna system is closer than one foot to any object other than the airplane itself. Do not use pliers or wrench in making radio installation or removal.

c. After Engine is Stopped. - Instructions for stopping the engine are contained in section XIII. If airplane is to be moored outside, see that parking harness is in place and that the airplane is properly anchored.

(1) Inspect for evidence of engine throwing oil and proper safetying of all drain plugs and covers.

(2) Inspect carburetor and fuel line connections for leakage. Check all safety wiring on the carburetor. Check throttle and all mixture control connections for tightness and proper safetying.

(3) Inspect voltage regulator and relay switch for security of mounting and cleanliness. Check terminals, cables, and connections, and vibration absorbing mounts for condition.

3. Column 20-Engine Controls.

a. Daily Inspection. - Inspect operation, proper functioning, and general condition of the following control assemblies: throttle, mixture controls, carburetor air heater, and propeller control.

b. 25-Hour Inspection. - Perform the operation of the daily inspection, but make a more thorough examination of all control assemblies, for the levers in the cockpit, through all the rods and cables. Examine the linkage, supporting brackets, guides, pulleys, and other connections. Check for lost motion, bent rods, frayed cables and loose, broken, or misaligned pulleys. See that all linkage is properly adjusted and that the controls operate with uniform tension.

Clean and lubricate all moving connections and bell cranks with oil (see section XIX), with the exception of antifriction bearings in bell cranks, rod, ends, and other items of like nature. Where antifriction bearings are used, no lubrication is necessary between major overhauls.

CAUTION: In areas where atmospheric conditions are conducive to forming corrosion, coat the cables with rust-preventive compound (Specification No. AN-C-52).

4. Column 21 - Engine Instruments.

a. Daily. - The daily inspection of engine instruments corresponds to the preflight inspection. Refer to part 2 of this section for details.

b. 25-Hour Inspection. - No specific procedures for a 25-hour inspection of the instruments of the A-25A Airplane are necessary. The preflight inspections are considered ample to maintain them until the 50-hour period is reached.

c. 50-Hour Inspection. -

(1) Inspect all instruments for chipped or discolored luminous markings, correct and discernible operation markings, security of mounting and tightness of connections. Check electrical instruments for condition of insulation.

(2) Engine Gage Unit. - Check as prescribed in preceding paragraph. Maximum allowable tolerances at zero are:

(a) Fuel pressure gage, plus or minus 0.2 pound.

(b) Oil pressure gage, plus or minus five pounds.

(c) Thermometer, plus or minus three degrees C.

NOTE: During cold weather, fill oil pressure line with light oil, as prescribed in section X, Instruments.

(3) Tachometer.- Check as prescribed above. Check electrical connections for security of mounting. Examine wiring for proper insulation. Maximum allowable tolerance is plus or minus 30 rpm.

(4) Manifold Pressure Gage.- In addition to the general instructions outlined above, check reading of instrument with station barometer. If it differs more than 0.4 inches of mercury, replace and turn in defective instrument for bench test.

(5) Cylinder Head Temperature Gage.- Inspect generally as prescribed above. Check indicator as to "ZERO" position. Adjust if necessary by opening the circuit at some convenient point, for example at the thermocouple or by removing one of the eye terminals from one of the studs on back of the indicator. After the circuit has been so opened, the instrument should indicate the temperature of the cockpit. Temperature of the cockpit is found by placing a standard mercury thermometer closely adjacent to the indicator and allowing sufficient time for the mercury thermometer to attain the same temperature with that of the indicator. The "ZERO" position of the indicator is then adjusted to agree with the thermometer reading.

(6) Thermometers.- Check marking of thermometers to determine if it is correctly marked to clearly identify the purpose for which it is being used. One of the following uses should be indicated by proper identification markings, using for that purpose either plates-name and date-drawing No. 015316-1, or aircraft enamel, Specification No. 3-98:

Carburetor air temperature

Cylinder head temperature

Engine oil temperature

NOTE: Section X, Instruments, details further inspection procedures for all instruments.

5. Column 22 - Ignition and Electrical System.-

a. Daily.- Check as prescribed for the preflight inspection. See that all connections are clean and tight, cables and terminals are in good condition, and that insulation is not excessively worn.

Inspect starter for cracked housing or flanges, for security of mounting, tightness of housing bolts, safetying of all attaching or connecting bolts. Replace starter if cracks appear in housing or flanges and tighten and safety bolts as required.

Excessive amounts of oil in starter gear case will cause an excessive drain on the storage battery and poor performance of the starter. When this condition is found, the starter should be replaced.

Check booster coil for operation.

b. 25-Hour Inspection.-

(1) Check gap setting of spark plugs. Gap should be .012 inch (+ .002 inch, - .001 inch).

(2) Check elbow terminals and shielding nuts for security.

CAUTION: When checking the elbow assembly of shield plugs, extreme care must be exercised to prevent rotation of the barrel with respect to the shell, since this will change the gap settings.

(3) Check howler system for proper functioning.

(4) Check spare bulb and fuse racks for spares.

c. 50-Hour.-

(1) Generator.- Inspect generator for security of mounting, excessive arcing, condition of connections and terminals, worn brushes and commutator, and cleanliness. See that safety wire is installed where necessary.

Clean any foreign matter from exterior of generator. Remove cover from generator and if "brush dust" is on or around brush rigging, blow it out with dry compressed air. If there is excessive arcing between the brushes and commutator, check for cause. If brushes are worn, replace. If commutator is rough or dark coated, smooth with No. 000 sandpaper. If necessary to replace brushes, refer to section XI.

CAUTION: Do not use emery cloth.

Should the presence of oil be noted at inspection, remove the generator and check the engine oil seal for leakage.

If the commutator is very rough, badly scored, pitted, or eccentric, it must be resurfaced. This work should be accomplished at the repair depot. Bad scoring or eccentricity can be detected by holding the pointed end of a pencil or similar object on top of the brush while the generator is running and, if the pencil is vibrated up and down by the brush, it can be considered that the commutator needs resurfacing, especially if sandpaper does not remove the vibration condition.

(2) Generator Control.- Inspect the voltage regulator and relay switch for security of mounting and cleanliness. As generator troubles, such as worn or sticking brushes, dirty or worn commutator and oil leakage may give the impression of voltage regulator trouble, the generator will be carefully inspected for these difficulties.

Inspect terminals, cable, and connections to see that they are in good condition. Check the vibration absorbing mounts for serviceable condition.

Inspect the condition of the contacts. Dirt generally can be removed by inserting a piece of clean paper between the contact, pressing the contacts together, and pulling the paper out. Be certain not to leave paper dirt between the contacts because this will reduce the voltage. Snapping the contacts open and closed may help to remove dirt.

CAUTION: When inspecting or cleaning contacts, the generator switch should be open.

Check the voltage regulator for 28.5 volts setting with no load, as set on initial installation.

(3) Starters.- The window strap on the motor of the starters should be removed and the motor inspected for loose connections and worn or binding brushes. Check spring tensions on all brushes. Check commutator for condition. Worn brushes should be replaced before their maximum wear limit is reached to insure proper operation between inspection periods. The maximum permissible brush wear is 5/32 inch from a new length of 1/2 inch. When replacing a worn brush, refer to section XI. Binding brushes and brush boxes should be wiped clean with a gasoline-moistened cloth (unleaded gasoline). Worn brushes should be replaced immediately as burning of the commutator and insulation usually results from failure to make such replacement in time. See that safety wire is installed where necessary. Make a brief check of the functioning of the starter.

WARNING: The ignition switch should be "OFF" when checking brushes, commutator, and electrical connections.

(4) Booster.- Inspect ignition booster for security of mounting. Note that a direct-cranking starter is used and that closing the starter switch should cause the booster to become energized.

(5) Switches and Solenoids.- Inspect for security of mountings, security of all electrical leads. Check condition and security of magneto ground wire.

(6) Ignition Shielding.- Inspect for proper anchorage and security of union nuts. Whenever it is necessary to solder any part of the ignition manifold assembly, the following will apply: Due to its resistance to high temperatures, only solder, Specification 57-99-1 (lead and silver rod, 1/8-inch diameter), will be used by service activities when repairing shielded ignition manifold assemblies. This solder will be applied with a soldering iron, properly heated; however, extreme care will be exercised to prevent burning any adjacent ignition cable insulation. Whenever possible, the ignition cable will be withdrawn from the parts that are to be soldered.

(7) Wiring.- Inspect all wiring, both high and low tension, for: proper anchorage of conduit nuts, bonding leads and terminal box covers, condition of connections, terminals, exposed ends and contacts, including ground connections. See that no leads are anchored to the fuel lines or engine controls and that none are swinging free in such a manner as to cause undue wear or fatigue.

NOTE: There are three inches of surplus wire tucked into manifold ring, which can be utilized whenever a new connection must be made because of damaged or frayed ends.

(8) Magnetos.- Remove breaker and inspect cam and breaker cup for excessive amount of lubricant. If any excess, remove breaker assembly and clean with gasoline, allowing to dry thoroughly; then apply three or four drops of oil, lubricating aircraft engine, grade 1100 or 1120 Specification No. AN-VV-O-446.

After application of oil, the felt should be soft and contain just enough lubricant so that oil can be brought to the surface when felt is squeezed.

Do not give it all it can hold and do not permit oil to drip from the felt lubricators nor to touch the breaker contacts. No additional lubrication of the breaker should be required between engine overhaul periods unless subsequent cleaning is necessary.

Under no circumstances will cosmoline, or any type of grease or lubricant other than that specified, be applied to the breaker mechanism.

(9) Battery.- Inspect the felt pad in the battery vent sump for proper condition. Saturate if necessary with sodium bicarbonate and water.

d. 100-Hour.- Replace all spark plugs with new or reconditioned plugs of the same type. Replaced plugs will be treated immediately after removal by immersing the shells only in rust preventive compound, Specification No. AN-VV-C-576, or in hot engine oil, Specification No. AN-VV-O-446.

e. 200-Hour.-

(1) Fluorescent Lamps.- Check lamp and lamp starting switch for satisfactory operation.

NOTE: If lamp is dark at the end, replace it.

f. 500-Hour Inspection.-

(1) Fluorescent Lighting.- Replace fluorescent lamp after 500 hours of operation.

6. Column 23 - Fuel System.

a. Daily Inspection.-

(1) With fuel "ON" and emergency fuel pump operating, inspect carburetor and fuel line connections for leakage, particularly at drain plugs, and parting surface of body castings. Inspect tanks for evidence of leaks at all tank connections and fittings.

(2) Fuel Selector Valve.- Check as specified under "Preflight Inspection" in this section.

(3) Carburetor. - Inspect for leakage at connections, drain plugs, passage plugs, and parting surfaces between body castings. Check throttle, mixture connections, and safety wiring.

(4) Fuel Pump. - Inspect pumps and fittings for signs of leaks, proper operation, and security of mounting. The relief valves should be set to maintain six to seven pounds per square inch and eight and one-half to nine and one-half pounds per square inch for the engine-driven pump and the emergency driven pumps, respectively.

NOTE: Drain fuel tank sump each time fuel is serviced to the tank. Drain out only enough fuel to remove any water or sediment that may have collected in the tank.

b. 25-Hour. -

(1) Fuel Pumps. - Three fuel pumps are incorporated into the fuel system of the A-25A Airplane. Two type G-9 pumps and a centrifugal pump are used on this airplane. Inspect pumps and fittings for proper operation and security of mounting. In case of faulty operation of the relief valve, or the bypass valve, of the G-9 pumps, remove valve assembly and inspect for foreign matter that may have lodged on the valve seat or valve. Wash the parts thoroughly and check valve for easy operation. Clear relief valve plug by inserting a drill or wire into the vent opening. Inspect for leaks and proper operation.

(2) Strainers. - Remove and clean all fuel strainer screens, (including carburetor screen). Inspect for breaks and tears. Clean strainer bodies. Replace screens, plugs, and drain valves and see that they are properly safetied.

(3) Carburetor. - Lubricate throttle shaft bearings and manual mixture control operating parts. Use oil, Specification AN-VV-O-446 for summer; and oil, Specification 2-27 for winter and extreme cold. Inspect parting surfaces between body casting; test screws with screw-driver for tightness.

(4) Fuel Lines. - With fuel "ON" and pressure built up to eight to ten pounds, inspect fuel lines and connections for leaks, cracks, security of anchorage, chafing, tightness, and condition of hose connections and hose clamps.

(5) Fuel Tank. - Check tank for evidence of leaks.

c. 50-Hour. -

(1) Inspect all safeties, controls, and connections of carburetor for security, leakage, and proper operation.

(2) At this inspection of the fuel valve controls, check the following items for conditions that would cause excessive backlash or drag; universal joints; cock-stem yoke pin; yoke-driven lugs and yoke; dial and handle assemblies; rivets and taper pins (check for looseness); shafts (check for interference with other parts); yoke driver and fuel cock yoke (check for interference.)

If excessive backlash or drag exists at any of these points the necessary repairs or replacements will be made. Backlash is not objectionable provided it does not exceed 15 degrees on installations incorporating short controls with one universal joint, and 30 degrees on complex installations incorporating long controls with several universal joints, gear boxes and other equipment.

(3) Fuel Selector Valve. - Excessive "drag" or friction in the fuel cock is indicated by stiffness and binding of the control when the indicator handle is turned. When this condition occurs, the control linkage will be disconnected at the fuel cock yoke and both the control linkage and fuel cock assembly will be checked for freedom of movement. Drag in the fuel cock assembly can be determined by turning the cock stem yoke with the fingers.

CAUTION: Whenever fuel cock controls are disconnected or fuel cock assemblies are removed or replaced, the reassembly of parts must be carefully checked to insure that the valve ports open to the tank positions indicated by the control handle pointer.

(4) Inspect all fuel overflow and drain lines for security of mounting, kinks, breaks, or stoppages.

d. 100-Hour. - Drain tanks and remove all access covers and sumps for thorough inspection. Refill anti-corrosion containers with potassium chromate crystals.

WARNING: Allow fumes to dissipate from fuel compartments for at least ten minutes after removing access doors before beginning inspection. If repairs are to be made, dry interior by blowing air in tank for several hours, overnight if possible, to remove highly explosive fumes.

e. Special - 10-Hour. - Remove cover plate on right-hand side of carburetor by loosening two Dzus fasteners and inspect cotter pin that holds metering arm cam roller in position.

f. Special - 15-Hour. - Check engine primer for leakage in the "OFF" position.

g. Special - Every Thirty Days. - Ascertain that marking, specifying that fuel system is "suitable for use of aromatic fuels," is discernible.

7. Column 24 - Oil System. -

a. Daily. -

(1) Inspect for evidence of engine throwing oil. Inspect all drain plugs and drain cocks for proper safetying.

(2) Check all oil system drain plugs and drain cocks for leakage and proper safetying.

During cold weather operation (below 32 degrees F), drain the oil pressure gage line and refill with hydraulic fluid, Specification No. AN-VV-O-366a.

b. 25-Hour. -

(1) Oil Lines and Connection. - Inspect all oil lines and connections for leaks, security of anchorage, wear due to chafing or vibration, dents, or cracks. Inspect connections for security of clamps, loose nuts, and proper location of clamps.

c. 50-Hour. -

(1) Inspect oil tank for security of mounting; signs of leakage, particularly at seams; condition and proper location of padding; proper tension of supporting straps; proper anchorage of oil lines leading from the tank.

(2) Remove and clean all oil screens and filters.

(3) Inspect the oil dilution stop-cocks to insure that there is no leakage at any point. Disconnect the dilution lines from the oil line, maintain fuel pressure, operate dilution switch. When the switch is open, there should be no leakage through solenoid valve.

NOTE: During cold weather operation (temperatures below 32 degrees F or below 0 degrees C), congealing of engine oil in the oil pressure gage line may cause the gage to be sluggish when the engine is started. When this condition prevails, the oil pressure gage line will be drained and refilled with hydraulic fluid, Specification No. AN-VV-O-366a. See section XVII, for procedure.

8. Column 25 - Cooling System.

a. Daily. - See that cowling is not rubbing fins and baffles.

b. 25-Hour. -

(1) Inspect baffles for damage. Check security of mounting. Inspect cylinders for damaged or broken fins.

9. Column 26 - Valves.-

This engine is equipped with internal automatic lubrication of the valve mechanism. The valve mechanism will be inspected and adjusted in accordance with instructions and periods as follows:

Prior to initial operation, fill the upper rocker boxes with engine oil of grade 1120, Specification No. AN-VV-O-446.

NOTE: A complete detailed inspection and adjustment of the valve mechanism will be made at the repair depots after the engine has completed the block test run.

a. 25-Hour.- A complete detailed inspection and adjustment of the valve mechanism will be made at only the first 25-hour inspection after the engine is installed.

10. Column 27 - Manifolds and Superchargers.

a. Daily.- Check manifolds for security of mounting and "blown" gaskets. Check security of mounting of carburetor air scoop.

b. 25-Hour.- Inspect exhaust collector rings for cracks. Check security of attachment.

c. 50-Hour.- Thoroughly inspect intake and exhaust system for "blown" gaskets, broken studs, cracked or damaged air ducts, or exhaust collectors, and security of attachment.

11. Column 28 - Propeller and Accessories.

a. Daily and 25-Hour.-

(1) Blades.-

(a) Thoroughly clean and visually inspect blades for damage or defects that may have occurred during previous operation. The blades are to be cleaned with a light lubricating oil and their inspection should include a careful check of the surfaces for damage such as bends, cracks, dents, and nicks. The full length of the leading and trailing edges as well as any dents or scars on the blade surface should be carefully examined for cracks. Each questionable scratch should be carefully examined to determine whether it is a scratch or crack. Raised edges of scratches, nicks, etc., which are likely to induce cracking, may be dressed off with a handstone or emery cloth.

(b) Damaged blades should be repaired only by activities having the proper equipment for the repair required. For other than field repairs, this should include equipment for the complete inspection of blades after repair, and also personnel trained in the proper technique for handling this type of work, so as to assure a high quality of workmanship and a satisfactory repair.

NOTE: Refer to section XII for care of blades at overhaul and repair of damaged blades.

(2) Controls.- Visually inspect the condition of all flexible propeller conduits where possible damage may occur. Any foreign matter that may accumulate on the conduit should be wiped off. Visually inspect condition of control rods in engine compartment.

(3) Operational Check.- The operation test should be made during the engine run-up. First, with the battery and generator switches and the circuit breaker "ON," the selector switch in "AUTOMATIC," the mixture control in "AUTOMATIC RICH," and the governor cockpit control in the "TAKE-OFF RPM" position, open the throttle until the engine is turning approximately 1000 rpm.

Then hold the selector switch in the "DECREASE RPM" position until a decrease of approximately 200 rpm in the engine speed is noted.

Now hold the selector switch in the "INCREASE RPM" position until the original engine speed is resumed. These tests show that the pitch changing mechanism is working properly.

Next, to check the automatic operation of the propeller, place the selector switch in "AUTOMATIC" and see that the governor cockpit control lever is in "TAKE-OFF RPM" position. Then open the throttle until the tachometer registers approximately 2000 rpm. Pull the governor cockpit control lever toward the "DECREASE RPM" position until a reduction of not more than 200 rpm is noted. At this rpm, the propeller should hold the engine at a steady speed without surges or other irregularities.

Return the governor cockpit control lever to the "TAKE-OFF RPM" setting. The engine should resume its original speed. Stop and cool the engine in normal manner.

b. 50-Hour.-

(1) Remove the brush assembly from the housing by releasing the two latches. Wipe the slip rings by holding a cloth against them while the propeller is being rotated and inspect the slip rings for wear. Clean oil and carbon dust from the brush holder and brushes with a clean dry rag or brush and make certain that the brushes slide freely in the holder. The brushes are inscribed on the side with an arrow pointing toward the end of the brush. When the point of wear of a brush reaches the tip of the arrow or beyond, the brush must be replaced.

(2) Examine electrical connectors, noting the condition of the sockets and pins. Coat the housing threads with anti-seize compound before replacement.

(3) Inspect the governor cockpit control levers to determine that they have at least one-eighth inch spring-back from the full forward position, as an assurance that the governor control is fully against the stop, which is set for "TAKE-OFF RPM." Adjust control rods, if necessary, but do not adjust the stop screw on the governor since it is already set to provide "TAKE-OFF RPM."

(4) Check the oil level in the speed reducer by removing the oil filler plug located near the front of the housing. The oil should be at the plug opening when the propeller is rotated until the opening is approximately 23 degrees below the horizontal plane, with the airplane at a ground angle of 15 degrees and approximately 8 degrees below horizontal when the airplane is level. Add oil conforming to Specification No. AAF-3563 as required; (Curtiss Speed Reducer Oil No. 2 conforms to this specification).

Lubricate the hub with low temperature grease, Specification No. AAF 3581 grade AA, by using a pressure gun on the grease fittings, located on the speed reducer housing just forward of front hub face, until the hub is completely filled. A solid flow of grease from the relief fitting will indicate that the hub is full.

c. 100-Hours.-

(1) Remove the switch compartment cover from the governor. Inspect the condition of the contacts. See that the wire leads are securely attached. Thoroughly clean contact assemblies with cleaning solvent or unleaded gasoline and remove any oil that may have accumulated in the switch compartment.

The contact points will not require dressing, although their contacting surfaces should be cleaned with crocus cloth or fine sandpaper. Place not more than one drop of light lubricating oil on the upper end of the shaft which supports the center contact assembly. Replace cover.

(2) Relay.- Partially remove relay from its box for inspection. Inspect for proper mating of contact points and sufficient contact point pressure.

There should be no unrestricted movement of the armature or transverse arms. Movement of the armature from the "NEUTRAL" position should be immediately opposed by pressure from the lower transverse arm spring. With the armature in "NEUTRAL" position, the lower transverse arm should seat at both edges of the armature T head, and at the same time rest against both coil bracket extensions. If the arm is bent at one end to center the armature, it must also be bent in the opposite direction at the other end, in order to maintain contact at all four points.

The four self-aligning brushings which locate the springs in the transverse cross arms should not extend through the arms so as to touch the face of the armature head.

Then in the "NEUTRAL" position, the armature should be aligned so that the gap, between the movable and fixed contacts, is .080 inch to .100 inch.

This adjustment is made by bending the upper transverse arm and/or the fixed contact supports.

When the armature stem is held solidly against the coil housing, there should be a gap of at least .008 inch between the outer edge of the armature T head and the upper transverse arm. This gap will be on the side of the closed contact in either direction. In order to obtain this gap, and at the same time maintain the clearance required in the above paragraph, it may be necessary to alter some of the previously made adjustments.

The Elkonite relay points are very hard and become discolored after continued service. The contact surfaces take on a charred appearance and develop very fine pit marks. These indications are normal characteristics of this material and do not affect in any way the operation of the relay as long as satisfactory contact pressure is maintained. The Elkonite points should not be dressed or polished as this only decreases the life of the contact and does not improve the operation.

The contact point material, as attached to the contact arm, is 1/8-inch thick. If this material becomes less than 3/32-inch in thickness at any point, due to wear or burning, the contact should be replaced. It should be noted that the surface of the movable contact is slightly rounded when new. The wearing off of the rounded portion does not impair operation. The purpose of this rounded portion is to facilitate the seating of the two contacts when first put into operation.

Satisfactory closing of the contacts should be made within 10 to 16 volts.

In the event that radio interference caused by the propeller is experienced, it will be desirable to test each condenser as follows:

Set an ohmmeter for high resistance range. Place one lead from the ohmmeter to the condenser case, the other lead to the contact. The ohmmeter will give a short, quick response, and at the same time the condenser will have received a slight charge. Immediately reverse the leads. This time the needle should again respond, and the extent of the deflection should be a little greater than the first, due to the slight additional charge stored up in the condenser.

A full and permanent deflection of the ohmmeter indicates that the condenser is shorted and the condenser should therefore be replaced. No motion of the needle is an indication that the condenser fuse is burned out and the assembly must be replaced. Before replacement, however, make certain that a satisfactory ohmmeter resistance has been selected.

Examine resistor for breaks in the porcelain casing. If the porcelain is badly broken, it is desirable to replace the unit. The resistance rating on the 24 volt relay is 800 ohms each side of center connection.

Make sure the armature floats freely on its pivot pin. Lubricate if necessary with a small quantity of oil or semi-fluid lubricant.

Examine all terminal and wire connections, making sure that one of them is loose and that there is no possibility of the terminals touching each other. Replace relay in box.

(3) Inspection of Moto. Housing.- Remove the motor cover. Inspect the general condition of the electric motor housing.

(4) Magnetic Brake.-

(a) Check the brake clearance by using a feeler gage between the inner ring of the end shield assembly and the rear brake plate. This clearance indicates the brake gap. It should be from .010 inch to .020 inch, and may be adjusted in the following manner:

1. Remove the thrust plate assembly.
2. Remove the three elastic nuts from the bolts on the thrust plate assembly and remove the front brake plate.
3. Add or remove shims under the front brake plate as necessary, to obtain the proper clearance.
4. Replace and secure the shims and the front brake plate.
5. Install and tighten the thrust plate assembly.
6. Again check the brake clearance.

(b) When the proper clearance is obtained, install and safety-wire the thrust plate assembly lock. The thrust plate assembly should always be screwed in tight, and should never be backed off to align the lock or to adjust the brake clearance.

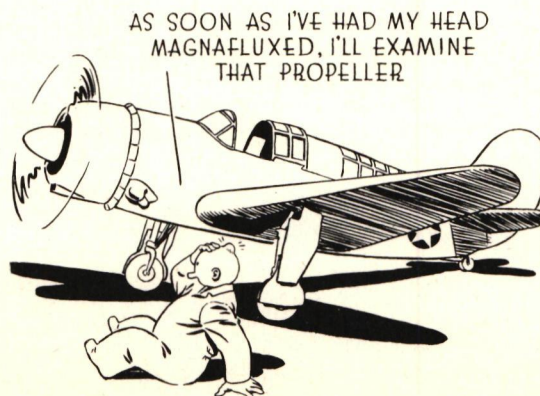
NOTE: In the event it becomes necessary to adjust the brake hub, proceed in the following manner:

Measure the hub clearance. This is the clearance between the hub and the rear brake plate when the brake is fully assembled. However, since this measurement is rather difficult to obtain when the brake is assembled, it may be taken with the thrust plate assembly removed, by measuring the clearance between the inner ring of the end shield assembly housing and the rear brake plate, with a feeler gage. This clearance should be .035 inch. To make this adjustment, proceed as follows:

1. Remove the thrust plate assembly lock. Using a thrust plate wrench, unscrew the thrust plate assembly.
2. Remove the brake disk.
3. Remove the cotter key from the shaft nut, and while holding the brake hub with a hub holder, remove the shaft nut.
4. Remove the hub with a hub puller. Remove the hub locating key from the shaft.
5. Lift off the top spacer and add or remove shim laminations to obtain the proper adjustment.
6. Replace in the reverse order. When the proper clearance is obtained, cotter the shaft nut.
7. After inspection, replace the motor cover and lock wire.

d. Special.- As soon as possible after a propeller strikes or is struck by any object, the propeller will be carefully examined for possible damage. A propeller involved in an accident will not be used before it is first disassembled and the parts carefully inspected for damage and misalignment. All steel parts will be magnafluxed. The aluminum alloy blades, if otherwise serviceable, will be given a general etching.

If for any reason the propeller is removed from the shaft prior to the required overhaul inspection, the propeller hub cone seats, cones, and other attaching parts will be inspected for galling, wear, bottoming, and proper fit. Before re-installation, all such defects will be corrected.



e. 750-Hour.- The overhaul of the propellers will be performed at this period. Each propeller assembly and governor installed will be removed and carefully disassembled and all parts thoroughly inspected. All ferrous parts will be inspected by the magnaflux system. This overhaul will be performed at service activities having proper facilities for this work.

At each engine change with the allowable propeller operating time, the propeller assembly, if visual inspection warrants, may be re-installed without overhaul, provided the total propeller time since last overhaul plus the maximum possible operating time for the replacement engine will not exceed the maximum time specified.

12. Column 29. - Power Plant - General.

a. Daily.-

(1) Check engine cowling and exposed portions of mounting brackets for security of attachment, cracks, deformation, and general condition of fasteners. Check exposed portions of engine mount and mounting brackets for security of attachment and general condition.

(2) Check intake pipes and exhaust manifolds for security of attachment and leaking gaskets. Inspect for evidence of engine throwing oil.

(3) Inspect vent lines for security of anchorage, clogging, breaks, or kinks, and to see that lines extend below cowling.

b. 25-Hour.- Open engine cowls and speed ring and make a thorough inspection of entire engine and mountings.

Oil sump plugs will be removed and inspected for the presence of metal particles. If pieces of the intermediate impeller pinion locks (flat pieces of metal approximately 3/64 inch in thickness) are observed, the engine will be removed and shipped to a depot for overhaul, and an Unsatisfactory Report submitted in accordance with the provisions of T. O. No. 00-25-10.

c. 50-Hour.-

(1) Engine Mount.- Carefully inspect engine mount for cracks, particularly at welds. Check tightness of mounting clamps and bolts. Inspect the protective coating. Inspect the vibration absorbing bushings.

NOTE: The maximum absorbing characteristics are obtained when the bolts are so tightened that the engine is restrained in a fore and aft direction, but is permitted to move in a torsional direction. Avoid excessive tightening of bolts.

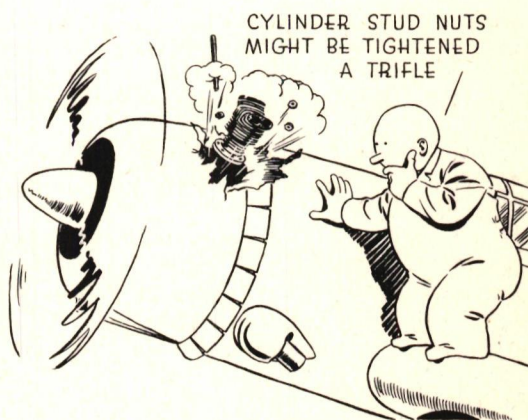
(2) Engine.- Inspect the cylinders for general condition. Check the tightness of cylinder stud nuts at first 50-hour inspection after installation, and at each second 50-hour inspection (100 hours) thereafter.

Inspect cylinder for general condition.

Check the compression on each cylinder. This should be done before the engine has thoroughly cooled after running. Detach all spark plug ignition wires and remove the front spark plugs from all cylinders except the one being tested. The compression should be checked at the first 50-hour inspection following installation and at each second 50-hour inspection (100 hours) thereafter.

d. 100-Hour.- Check tightness of rocker box cover stud nuts. Avoid excessive tightness.

CAUTION: Tighten two center nuts and two outer nuts with 80-inch pounds torque.



e. Special - Engine Change.-

(1) At Installation.- Refer to section XIII for preparation of engine for service following storage, periods of idleness, or block test.

(a) Ground Test.- Whenever a new or overhauled engine is installed in the airplane, the installation will be ground-tested by running the engine for a period of approximately 30 minutes, during which time the operation of the engine, engine instruments, and related accessories will be thoroughly checked for proper functioning. Care must be taken not to exceed maximum cylinder or oil temperature during this period. Continued operation at either low idling speeds or at manifold pressures approaching rated power must be held to the minimum. Engine cowling will not be installed during this ground running.

Warm-up speeds of 1000 to 1200 rpm are recommended. Operation on the ground with speeds and manifold pressures that will give rated power will be limited to short bursts of only sufficient duration to obtain instrument readings and to make certain that the acceleration of the engine is satisfactory.

NOTE: Remove and clean all oil screens and strainers in newly installed engines at expiration of engine installation and adjustment run-up, prior to flight, and again at expiration of the necessary flight test.

(b) Flight Test.- Upon completion of the installation ground tests specified above, each airplane in which a new or overhauled engine has been installed will be flight-tested as specified below:

A flight of approximately one hour's duration at reduced power, followed by a careful inspection for evidence of any visible defects, malfunctioning parts, etc.

An additional two hour's flying at reduced power prior to release of the airplane.

In the case of airplanes to be flown from the plant of the contractor, a minimum of three hour's flying time will be flown as specified in Army Air Force Circular 15-262 before the aircraft is cleared for departure to destination.

The mixture control will be kept in the full "RICH" position at all times during the flight tests, except for intervals necessary to test in flight the operation of the automatic mixture control.

(c) Vibration Absorbers.- Inspect engine vibration absorbers for evidence of any failure of the rubber bond, or for excessive disintegration of the rubber from gasoline and oil. Where there is evidence of deterioration or excessive wear, the vibration absorbers will be replaced.

(d) Engine Accessories.- When replacement pumps are available, all accessory pumps (except those with less than 100 hours since last overhaul) will be replaced. This includes fuel, vacuum, and similar power-driven units.

(e) Oil System.- The oil is changed, and oil sump drained. Since this airplane has a hopper-type oil tank, the lubricating oil is drained only at engine change, except where some unusual circumstance, such as the failure of an engine part, makes it advisable to change the oil before that time. It is impracticable to specify one grade of oil for use under all climatic conditions. However, most operations fall within the ground temperature range of 4 degrees C (40 degrees F) and above, for which grade 1120 is specified. This grade should therefore be considered the standard for Army Air Forces use, except in cases where, in the opinion of responsible engineering officers, another grade should be used.

The following table lists the grades of aircraft engine lubricating oil with corresponding SAE viscosity ratings:

TABLE I			
Grade Designation Spec. No. 2-91	Grade Designation Spec. No. AN-9532	Grade Designation Spec. No. AN-VV-O-446	Equivalent Commer- cial SAE Grade No.
62	1065 Class B	1065	30

Grade Designation Spec. No. 2-91	Grade Designation Spec. No. AN-9532	Grade Designation Spec. No. AN-VV-O-446	Equivalent Commer- cial SAE Grade No..
77	1080 Class B	1080	40
98	1100 Class B	1100	50
120	1120 Class B	1120	60
	1150 Class B	1150	70

Table II lists the three grades of oil in general use with recommended operating temperature ranges.

TABLE II.

Grade Oil	Air Temperature at Ground	Safe Maximum "Oil-In" Temp.	Safe Minimum "Oil-In" Temp.
1120	4°C (40°F) and above	95°C (203°F)	20°C (68°F)
1100	-7° to 27°C (20° to 80°F)	85°C (185°F)	10°C (50°F)
1080	100°C (50°F) and below	75°C (167°F)	0°C (32°F)

Grade 1065 and grade 1150 may be used at the discretion of the engineering officer for extremely cold and extremely hot climatic conditions.

NOTE: By employing the oil dilution system to facilitate starting in cold weather, the airplane can be operated in all temperature conditions with grade 1120 oil. However, it may be more desirable to use grade 1100 oil with ground temperatures below 4 degrees C (40 degrees F). Oil lighter than grade 1100 should not be required when using the oil dilution system.

It will be necessary to place one-half to one pint of oil, grade 1120, Specification AN-VV-O-446a, in Nos. 5, 7, and 9 rocker boxes before engine run-up. Due to the inverted position of the cylinders, it is desired that the oil be frozen with dry ice or other means, then packed into rocker box. However, if facilities for freezing the oil are not available, it is satisfactory to remove the lower cowl stud on the rear exhaust rocker box for filling with oil. After filling, replace the stud, using thread compound. Make certain that the projecting height of the stud is the same as before removing so that no interference is encountered with the rocker arm by tightening this stud an excessive amount. After inserting stud make certain that it is safetied to the upper stud. Any action taken should be noted on form 60B.

f. Instruments.- Check marking of instruments to insure that they indicate the operating limits prescribed in the Flight and Operation Handbook for the airplane and engine.

Thoroughly inspect all electrical junction boxes to insure the connector panels, fuse clips, plugs, wiring, etc., are properly wired or installed and securely anchored. Check propellers for hours since last overhauled. The propeller may be re-installed provided it meets visual inspection, and the total time since last overhauled plus the maximum possible operating time for the replacement does not exceed 750 hours.

(1) 25-Hours After Engine Change Inspection.-

(a) Valve Clearances.- They should be .010 inch. Check for broken valve springs, washers, or other failures.

(b) Valve Adjustment.- Rotate propeller (normal) until No. 1 cylinder is on top dead center on firing stroke. Adjust screw to .010 inch tappet clearance and lock with valve rocker cap screw. Test valve adjusting screw with a screwdriver for tightness. Adjust in firing order 1-10-5-14-9-4-13-8-3-12-7-2-11-6, turning to each cylinder in firing order. If difficulty is experienced in obtaining clearance, it may be due to stretched valve or bent push rod.

(c) Rocker Box Cover Gaskets.- See that gaskets are in good condition.

(d) Propeller.- Tighten engine thrust bearing nut, if necessary, using proper wrench, taking care not to tighten excessively.

(e) Intake Pipe Packing Nuts.- Inspect for tightness.

(f) Hydraulic Pump.- Remove the pump and check the freedom of motion of the rotating parts. Test by turning the drive coupling with the fingers. Should excessive resistance to rotation of the moving parts of the pump be found, the pump will be returned to the depot for overhaul.

13. Column 31 - Cockpits and Cabins.

a. Daily.-

(1) Cockpits and Cabins.- See that the cockpit is clean and that there are no loose articles that can jam the controls or otherwise interfere with the operation of the airplane. Inspect operation of emergency release mechanism. Make certain that emergency releases are securely in place at end of the inspection.

(2) Heater and Ventilator.- Inspect the mixing chamber and ducts for leaks. Check operation of the controls.

b. 25-Hour.-

(1) Seats.- Inspect seats for security of attachment, including supports and brackets. Check condition and functioning of adjusting mechanism. Inspect the seat and back for breaks and cracks which might foul parachute harness or clothing. Lubricate seat adjustment with oil, Specification No. AN-VV-O-446.

(2) Safety Belt.- Visually inspect the installed belts and replace if there is any indication of defects or deterioration. Check the fabric and leather parts carefully for cuts or fraying. Check the latching device for free operation and bent or damaged parts. Check all attaching parts and fittings for security of fastening. Check the date the belt was last tested and if more than the required six month period has elapsed, the belt will be removed to be tested and replaced by one tested within the specified time period.

(3) Windshields and Windows.- Inspect the frames, noting their condition and also security of attachment. Inspect transparent sheets for breaks or cracks. Check opening, closing, and latching of canopy.

14. Column 32 - Flight Control Mechanism.

a. Daily.- Inspect all flight controls for freedom of operation.

b. 25-Hour.-

(1) Rudder Controls.- Inspect rudder pedal assemblies for proper condition and functioning of all parts, including pedal adjusting mechanism. With pedals in "NEUTRAL" position, see that the rudder is also in "NEUTRAL" position. If lost motion exists or if full movement of the rudder cannot be secured without binding, thoroughly inspect the entire system to locate and correct the trouble. Check clearance between rudder and elevators in extreme position of travel. All accessible parts will be wiped clean.

(2) Elevator and Aileron Controls.- Inspect the control column assembly for proper condition and functioning of all parts. See that both control wheels turn freely, yet without play, throughout their entire range.

Check the throw of elevators and ailerons. Look for bent or damaged tubes or shafts. With the control column and wheels in "NEUTRAL" position, see that the elevator and ailerons are in "NEUTRAL" position. If lost motion exists or if full movement of the control surfaces cannot be obtained without binding, thoroughly inspect the entire system to locate and correct the trouble. All accessible parts will be wiped clean.

(3) Flight Control Linkage.- Make a thorough inspection of all cables, pulleys, guides, drums, bell cranks, push-pull control tubes, and similar equipment. Check the safetying of all turnbuckles and attachments.

Inspect airplane control cables for general condition. Control cables that are found to be frayed (individual wires broken), will be considered serviceable unless there are more than five broken wires in any one-inch length of the cable. At each 25-hour inspection, the number of broken wires will be carefully noted, particularly where the cables pass over pulleys or guides. Only those with broken wires in excess of the number specified in any one-inch length need be replaced.

Airplane control cables are regularly oversize and their strength is usually 50 percent in excess of the design loads to be sustained. Because of the number of wires in these cables, their failure is never abrupt, but is progressive over periods of extended use. Most broken wires show up soon after cable is placed in service, probably because some of the wires are under greater tension or are much harder than the rest. After these wires have broken, very few additional broken wires will be encountered in normal services for considerable time. The loss in cable strength from broken wires generally depends upon the concentration at one point rather than on the total number in the cable.

Look for loose brackets, fittings, turnbuckles, bolts or nuts, and for elongated bolt holes. Inspect for misaligned or broken pulleys or fair-leads. Check alignment of all moving parts. Make certain that cables and rods are not chafing structural members and are passing freely through the slots or holes provided for them.

(4) Flap Controls.- Inspect the flap control linkage, from the knob on the control pedestal to the flap operating cylinder, for proper condition and functioning. Inspect for linkage connecting the two flap sections, noting condition of linkage and security of attachments.

Inspect the flap operating gear box and motor for security of attachment and general condition. Look for evidence of leakage of hydraulic fluid. Inspection and maintenance of the flap gear box and motor is also discussed under the hydraulic system, column 39, of this section.

Check to see that position indicator is functioning and correctly shows the position of the flaps.

(5) Trim Tab Controls and Linkage.- Inspect for proper condition and functioning of all parts. Note that indicators show the position of the tabs. Check all tabs for proper throw. (See fig. 3-IV.)

Inspect cables, rods, and attachment fittings for condition, security of attachment, and proper safetying. Note any signs of interference with other parts or assemblies. If lost motion exists, or if full motion of the tabs cannot be obtained without binding, the entire system should be rigidly inspected to locate and correct the trouble.

(6) Adjustment.- Adjustments of the surface control mechanism are considered minor repair, and are therefore discussed under "Surface Controls" section IV.

c. 50-Hour: Repeat 25-Hour Inspection.-

(1) Lubrication.- The internal parts of the control units will normally require oiling only when they are removed from the airplane for overhaul. For detailed instructions on lubrication see section XIX, of this Handbook.

15. Column 33 - Movable Surfaces.

a. Daily.- Inspect all surfaces for cuts or holes or other visible damage, and for general condition.

b. 25-Hour.-

(1) Ailerons, Elevators, and Rudder.- Inspect for free and full movement of all controls and movable parts. Look for warping. Carefully inspect the metal covering for wrinkles, loose rivets, or tears around rivets. The control surfaces are of stressed skin construction. Therefore, a skin in satisfactory condition, with sound, tight riveting, is an indication of a sound, internal structure. Check security of attachment of removable tips.

(2) Flaps and Trim Tabs.- Inspect for free and full movement. Look for warping, especially on the outer panel flaps. Carefully check condition of skin and riveting.

(3) Horns and Hinges.- Inspect horns and hinges for bends or breaks, security of attachments, worn or loose hinge pins, and safetying.

(4) Flap Position Indicator.- The flap position indicator is discussed in section IV.

16. Column 34 - Fixed Surfaces.

a. Daily.- Inspect general condition of metal covering.

NOTE: Any buckling or displacement of the skin, especially between the front and rear spar, is an indication of a major structural failure, and should be investigated immediately. This applies to the vertical and horizontal stabilizers as well as the wing.

b. 50-Hour.- Inspect for torn or loose metal skin. Look for loose rivets, or rivets pulling through the skin. Inspect for loose or broken ribs in the leading edge and trailing edge sections. Check security of attachment of the tips. Inspect mounting of landing lights and navigation lights. Inspect wing splice (center panel attachment) inside bomb bay of the fuselage for security of attachment, cracks, or elongated holes.

Check horizontal and vertical stabilizer attachments for security. Look for cracks or elongated holes.

17. Column 35 - Fuel Tanks.

a. Daily.- The preflight procedure of opening all drains and removing water and sediment from the tanks should be performed at that time.

b. 50-Hour.-

(1) Inspect fuselage tank for security of mounting, leakage, condition of padding, tension of hold-down straps, and condition of gaskets.

(2) Inspect fuel lines leading from tanks for proper anchorage.

c. 100-Hour.-

(1) Remove access doors to self-sealing wing tanks and inspect for leakage, particularly at fitting and fuel duct connections. Inspect fuel lines for proper anchorage.

d. 300-Hour.-

(1) Inspect corrosion-resistant cartridge drain assemblies.

(2) Inspect wing tanks for signs of corrosion.

18. Column 36 - Tail Gear.

a. Daily.-

(1) Tail Gear.- Inspect tail wheel assembly for freedom from mud, grass, and other impediments. Check condition of shock unit, supporting tail wheel in proper position.

NOTE: Strut clearance, with normal load, is 1-5/8 inches to 1-7/8 inches.

Check tail wheel bearings for side play and freedom of operation.

b. 25-Hour.- Lubricate as specified on fig. 1-XIX.

c. 50-Hour.- Inspect entire assembly for cracks, breaks, or bends, particularly at sharp

angles and at welds. Check fluid level of shock strut. If fluid is below the proper level, add the necessary amount of fluid, Specification No. AAF-3580, medium grade. Strut clearance should be 1-7/8 inch.

Inspect attachment fittings for cracks, breaks, or bends. Check operation of swivel release mechanism.

d. 200-Hour. - Lubricate as specified on fig. 1-XIX.

Remove the tail wheel bearings, clean with a suitable grease solvent, and if found serviceable, relubricate and reassemble. If bearings are found to be unserviceable, they will be replaced. Tail wheel anti-friction bearings will be lubricated with grease as specified below. No lubricant will be applied in the center of the hub between the bearings or in the outer dust cap.

For Winter Use. - Grease, lubricating, high melting point, soft or medium, AAF Specification No. 3560.

For Summer Use. - Grease, lubricating, aluminum soap grease, grade B, medium, Specification No. AN-G-4.

Re-install wheel and adjust to the point that all appreciable side play or shake is eliminated. However, care must be taken that the bearings are not drawn up too tightly and that the wheel revolves true and free after this operation.

19. Column 37 - Landing Gear.

a. Daily. -

(1) Landing Gear. - Inspect for general condition of struts, braces, and fittings. Note bottoming of struts. Inspect for evidence of leakage of fluid or pressure.

b. 25-Hour. - Inspect struts, braces, and fittings for cracks; bends; security and condition of attachment fittings; elongated bolt holes; loose, missing, or unsafetied bolts, nuts, or cotters.

Lubricate as specified on fig. 1-XIX.

c. 50-Hour. -

(1) Inspection. - Support the airplane on jacks or cradles so that the landing gear retracting mechanism may be operated. Thoroughly inspect all landing gear attachment fittings, bolts, bell cranks, arms, supports, and other like equipment.

Test functioning of retracting and lowering mechanism by operating the engine-driven pump. Repeat test, using emergency hand pump instead of engine-driven pump. Also check operation of the emergency landing gear cable releases.

NOTE: Additional inspection of the retracting mechanism will be made as prescribed under "Hydraulic System," section IX.

Check functioning and general condition of the warning system. See fig. 11-XI and also refer to section XI for a description. See that the landing gear position indicator correctly indicates the position of the landing gear. If necessary, adjust as outlined in section IX.

The shock struts will be filled as per the following instructions:

Use hydraulic fluid, Specification No. AAF-3580, medium grade. Back off the filler plug slightly, until all "fizzing" of air and fluid ceases. Remove filler plug and fill the strut with fluid until the fluid is level with the hole. Insert the plug loosely and cause the strut to completely extend and collapse several times, preferably by raising and lowering the airplane with a hoist, or jack, to eliminate air traps in the strut. Remove the plug and again check fluid level. If necessary to add more fluid, the above procedure will be repeated until the proper fluid level is obtained. Replace the filler plug carefully so as not to damage the threads or the valve stem. The copper gasket should be replaced to avoid leaks.

With the fluid at the proper level, inflate the strut in accordance with instructions on plate attached to the strut. Rock the airplane while inflating so that the strut will alternately extend and compress, to overcome packing friction. When fully inflated, all the struts must have the proper extension, which is 5/8-inch from the packing nut to the lower flange of the piston. Checking and adjusting of strut inflation should be done on a reasonable level surface, sheltered from the wind, with the airplane in taxiing position and fully loaded. Be sure that the struts have been extended and compressed several times before checking and adjusting is attempted.

d. 200-Hour.- Wheel bearings will be lubricated in the same manner as specified in column 36, this section.

20. Column 38 - Wheels and Brakes.

a. Daily.- Inspect wheels for bent or distorted rims. Check security of retaining nuts. Air pressure in tires should be 55 pounds.

b. 25-Hour.- Make a thorough inspection of the brake system from the operating pedals to the brake drums. Brakes should be adjusted so as to hold the airplane at full throttle but not drag when released. They should be adjusted with equal tension. Brake pedals should be so adjusted that their operation will be unhindered with the pedals fully depressed and the rudder full "ON."

NOTE: The pedal adjustment should be such that the pedals may move slightly toward the "ON" position before the brakes actually "take hold" in order to prevent accidental application of the brakes.

Check the brakes for air entrapped in the hydraulic lines. Slowly applying and releasing the brakes several times should work out the air. If this fails to remove the air, bleed the lines as described in section IX.

c. 50-Hour.- Inspect hydraulic lines and connections for deterioration of flexible lines, leaks, kinks, twisted and damaged piping and connections.

(1) Wheels.- Inspect for excessive side play and shake, also interference between wheel and backing plate.

(2) Wheel Brake Unit.- Inspect brake discs for scoring and undue wear or dishing.

Inspect brakes for entrapped air (soft spongy feel to brake action) and for leakage at brake cylinder. Check and adjust clearance between brake discs, with two or three feeler gages. Clearance should be .050 to .055 inch.

Brakes should be adjusted to equal tension so as to hold airplane steady at full throttle.

Brake pedals should be adjusted so that with the pedals fully depressed and rudder full "ON," the brake pedals will not be hindered in operation.

CAUTION: Brake pedals should be adjusted to allow some small movement toward the "ON" or braking position, before the brake actually takes hold to avoid accidental application of the brakes by the pilot.

(3) Entire Assembly.- Inspect for cracks in wheel casting, corrosion, condition of protective coating, dents in rims or discs, snugness of fit of valve stem washers, and loose wheel rivets.

(4) Tires and Rims.- The tires and rims will be removed and carefully inspected for the following conditions:

Check inside of casting for ruptures or breaks. Check beads for physical damage extending through the outside rubberized chafer fabric. Check sidewalls, both inside and out for breaks, cuts, blisters, loose cords, or other serious physical damage. Check tread for cuts through or cuts which expose the fabric carcass to moisture or dirt. Check tread wear for exposure of the fabric carcass of the casing.

If tread cuts are present but do not penetrate the fabric, the cut will be cleaned and

filled with commercial tire cut filler, cemented in place. (Cement, rubber tire cut fillers, will be procured locally as required.) If sidewall blisters are present that can be cleaned with no damage to the fabric carcass, or if the rubber fairing immediately above the rim flange separates from the fabric carcass with no injury to the carcass, the damaged areas will be cleaned and repaired with airship rubber cement, Specification No. AN-C-54 (class 04-B).

Inspect valve for physical damage, or faulty attachment to the tubes. Inspect tube body for evidence of wrinkles and creases, thin spots, cuts, or punctures. Inspect for chafing of tube due to rubbing of bead. Inspect for damaged areas resulting from casing breaks.

If any defects or damages are found, the tube will be repaired if possible, otherwise it will be replaced. Tubes having extra wall thickness at the portion in contact with the wheel rim need not be replaced if wrinkles occur at that point, provided that there is no evidence of damage because of chafing.

Examine rim for cracks or damage due to careless use of tire mounting tools or impact from any object. Rims will be thoroughly cleaned if corroded or dirty. If protective coatings are worn through to the metal, such areas will be refinished and allowed to dry before remounting the tire and tube.

In order to obtain maximum balance between tire and tube assembly, the balance marker of the inner tube (representing the heavy spot of the tube) must be mounted next to the red balance marker on the casing representing the light spot of the casing.

NOTE: Tires that are known to have struck large stones or other damaging objects, or to have been subjected to similar abnormal usage during service, will be removed by local maintenance personnel and inspected for possible damage to casings and tubes whenever deemed necessary by local engineering officers.

(5) Adjustment.- Install the wheel and the wheel bearing nuts on axle. Be sure there is no brake drag. Then with the wheel spinning, tighten the adjusting nut slowly until a bearing drag on the spinning wheel is noticed. Back off the nut to the next castellation and lock in position with a cotter pin. Brake drag shall not be confused with bearing tightness while rotating the wheel during bearing adjustment. Check for side play. Bearings shall not be adjusted too tightly as cracked bearing cups may result.

Wheels are made of aluminum or magnesium alloy, which corrodes very rapidly unless carefully protected. Except on friction and bearing surfaces, the entire wheel shall have a protective coating. Parts that have this protective coating chipped off, worn through, or removed in any other manner, will be refinished immediately to prevent corrosion. At no time shall wheels that are corroded on the inside be used.

Wheels which do not run true, and wobble somewhat when rolled on a level surface, will be condemned. Wheels which have badly distorted reinforcing ribs or rims will also be condemned. Wheels in which cracks develop will be reported to the Materiel Center for disposition.

d. 100-Hour.- With wheel removed, inspect entire brake assembly for corrosion and broken or distorted parts. Inspect to see that grease from the inboard wheel bearing or fluid from the brake cylinder has not come in contact with the discs. Check for security of nuts, bolts, and cotter pins.

21. Column 39 - Hydraulic System.

a. Daily.-

(1) Inspect all accessible lines and connections for leakage. Inspect all hydraulic system units and replace packing as soon as leakage develops. See section IX for additional information on the hydraulic system, including directions for bleeding the system.

(2) Check fluid level in reservoir. Fill to overflowing with mineral oil conforming to Specification No. AN-VV-O-366a.

b. 25-Hour.-

(1) Clean strainer screen in filler neck of reservoir.

(2) Inspect condition and functioning of all valves, flap actuating motors, landing gear and tail gear retracting struts, gunner's seat strut, displacing gear strut, turtleback strut, gun charging units, bomb bay door struts, and hydraulic hand pump.

c. 50-Hour.-

(1) Inspect accumulator for indication of leaks.

(2) Check pump for security of mounting, tightness of nuts, and line connections.

NOTE: The pump will be removed and checked for freedom of rotating parts at the first 50 hour inspection only after initial installation.

d. 100-Hour.-

(1) Check tightness of pipe connections at pump; and, for tightness and safetying of all nuts.

22. Column 40 - Fuselage.

a. Daily.- Inspect the fuselage for general condition and for tears or cuts in the metal covering. Look for distortion, which indicates damaged structural members.

b. 50-Hour.-

(1) Inspect all accessible parts of exterior and interior of fuselage for bent longerons and braces.

(2) Inspect structural members for cracks, particularly at sharp bends. Look for loose members, bolts, or rivets. See that inspection doors are properly attached. Inspect all accessible parts of the metal covering and protective coating for evidence of corrosion.

(3) Shock Absorber (Bungee) Cord.- Inspect for tension. All 5/8-inch shock absorber cord subjected to continuous loading will be installed with an initial pressure of 100 pounds.

23. Column 42 - Night Flying Equipment.

a. Daily.-

(1) Inspect functioning and condition of all lights. See that spare fuses are in place.

24. Column 43 - Miscellaneous - Airplane General.

a. 100-Hour.- To clean oil separator, remove entire separator and thoroughly clean, using a suitable solvent. Dry with compressed air and re-install. If equipped with vent plug (plug marked PRESS) remove the clean passage.

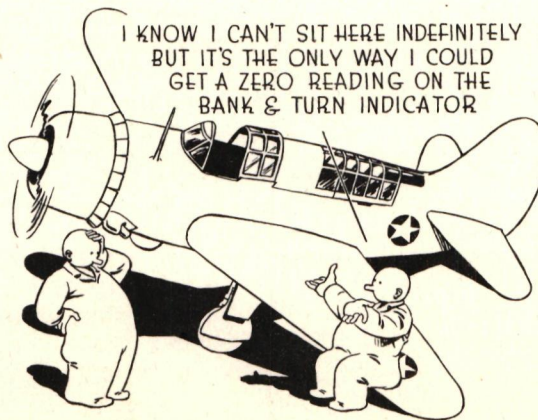
Check microphone, cords, etc., for proper anchorage to prevent jamming controls.

25. Column 44 - Navigation Instruments.

The flight and navigation instruments will be inspected as follows:

a. 50-Hour.-

(1) Bank and Turn Indicator.- Inspect for broken or loose cover glass, security of mounting, and all lines and connections for tightness, flexibility, and anchorage. Inspect the inclinometer for discolored liquid and free action of the ball. Check for discolored or chipped luminous markings. Check pointer for proper "ZERO" position when airplane is on the ground.



Check lubrication.

(2) Air-Speed Indicator. - Inspect for broken or loose cover glass, security of mounting. Inspect all lines and connections for tightness, flexibility, and anchorage; for discolored or chipped luminous markings, and inspect the air intake screens for cleanliness.

(3) Altimeter. - Inspect for broken or loose cover glass, and for security of mounting. Check static lines for leaks, tightness, flexibility, and anchorage. Inspect for chipped or discolored luminous markings. Inspect for synchronism of barometric scale and reference markers, and for zero setting error.

(4) Rate of Climb Indicator. - Inspect for broken or loose cover glass, security of mounting, all lines and connections for tightness, flexibility, and anchorage, and for discolored or chipped luminous markings.

(5) Air-Speed Tube. - Inspect tube for cleanliness and proper alignment. Check pitot, static, and drain holes for obstructions. Check the tube assembly installation for leaks and obstructions.

(6) Compass. - Inspect for signs of liquid leakage, security of mounting, broken or loose cover glass, and damaged or lost external parts. Check for dirty or discolored damping liquid, discolored or chipped luminous markings, and for evidence of unbalanced card element. Check correction card for proper compensation date. Check verge ring for freedom of operation. Check for evidence of bubbles due to insufficient liquid. Check the compass. If necessary to compensate, see procedure in section X.

(7) Fuel Level Gage. - Inspect for proper lighting, broken or loose cover glass, security of mounting, discolored or chipped luminous marking, all leads and connections for security and proper anchorage. Check indicators on the gage with known contents of the tank. Check tank unit for defective float and freedom of operation.

b. 100-Hour. -

(1) Bank and Turn Indicator. - Check installation at suction connections.

Remove plug under word "OIL" on the right side of the case, and add lubricant as follows: For operating conditions in which atmospheric temperatures are above freezing (0 degrees C or + 32 degrees F), add eight drops of gyro instrument oil, Specification No. 3563. For operating conditions in which atmospheric temperatures are below freezing (0 degrees C or 32 degrees F), add eight drops of a mixture of 1/3 compass liquid, Specification No. AN-VV-C-551, and 2/3 gyro instrument oil, Specification No. AAF 3563.

Care should be exercised that all of the oil is inserted in the rotor pivot. A fine wire (approximately .015 inch diameter) should be used to guide the oil into the hole in the pivot. Any excess of spilled oil may be a source of unsatisfactory operation. To perform the above lubrication, the bank and turn indicator must be removed from the airplane.

The jet cover, which is located on the top of the instrument case at the rear, should be removed and cleaned. The drain plug, which is located on the bottom of the instrument near the front, should be removed to allow collections of oil and water to drain out of the instrument.

Ground-test the suction at the instrument under normal cruising rpm of engine. To make this test, connect a type F-1 or F-2 suction gage to the pressure test connection on the instrument or on the bank and turn vacuum control valve. The suction should be between 1.80 and 2.05 inches of mercury. The source of suction may be vacuum pump on the engine or portable test equipment.

(2) Fuel Level Gage. - Inspect the fuel level gage tank unit for corrosion of moving parts, security of connections, and general condition. Directions for adjustment are given in section IV. When re-installing tank unit, seal gasket with Thiokol C-2.

NOTE: This inspection may be eliminated if the gage unit is removed for inspection at the first evidence of malfunctioning.

Compensate compasses as specified in section X.

26. Column 46 - Battery.

Inspect and maintain battery as noted below:

a. Weekly; Once Each Seven Days.- Inspect for security of mounting and condition of the container; also see that drain tube is unobstructed. Test the specific gravity of each cell with a hydrometer, returning the electrolyte to the cell from which removed, and record on Army Air Forces Form No. 41-A, column 46, the reading of the cell having the lowest gravity. In case the gravity is 1.200 or lower, the battery will be replaced with one that is fully charged.

CAUTION: Avoid spilling electrolyte on the airplane skin or structure. If spilled, wash parts as soon as possible with ammonia to neutralize acid, then flood with water. Do not allow the ammonia to get into the battery.

Add distilled water where necessary using the type D-1 battery servicing kit, Specification No. 40572, and ascertain proper level with the self-leveling syringe. Inspect battery leads for condition of insulation. Inspect terminals for security and remove any dirt or corrosion. This can be accomplished by using a solution of baking soda (bicarbonate of soda). After removing the corrosion, apply a light coat of vaseline to the battery terminals, except in the case of shielded batteries on which the terminals are not exposed to battery gases, and hence require no vaseline.

Inspect for leakage of acid due to broken case or defective sealing. If evidence of leakage is found, the battery will be replaced. Whenever batteries are removed, the containers will be cleaned of any corrosion and, when necessary, recoated with acid-proof lacquer. Specification No. 3-168.

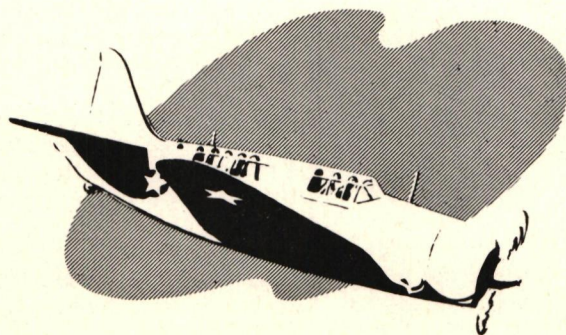
When the airplane is to remain idle for more than one week, the battery will be removed and turned into the battery room for storage.

b. 25-Hour.- Inspect the felt pad in the battery sump for proper condition and resaturate, if necessary.

The following are hydrometer readings for commonly used batteries:

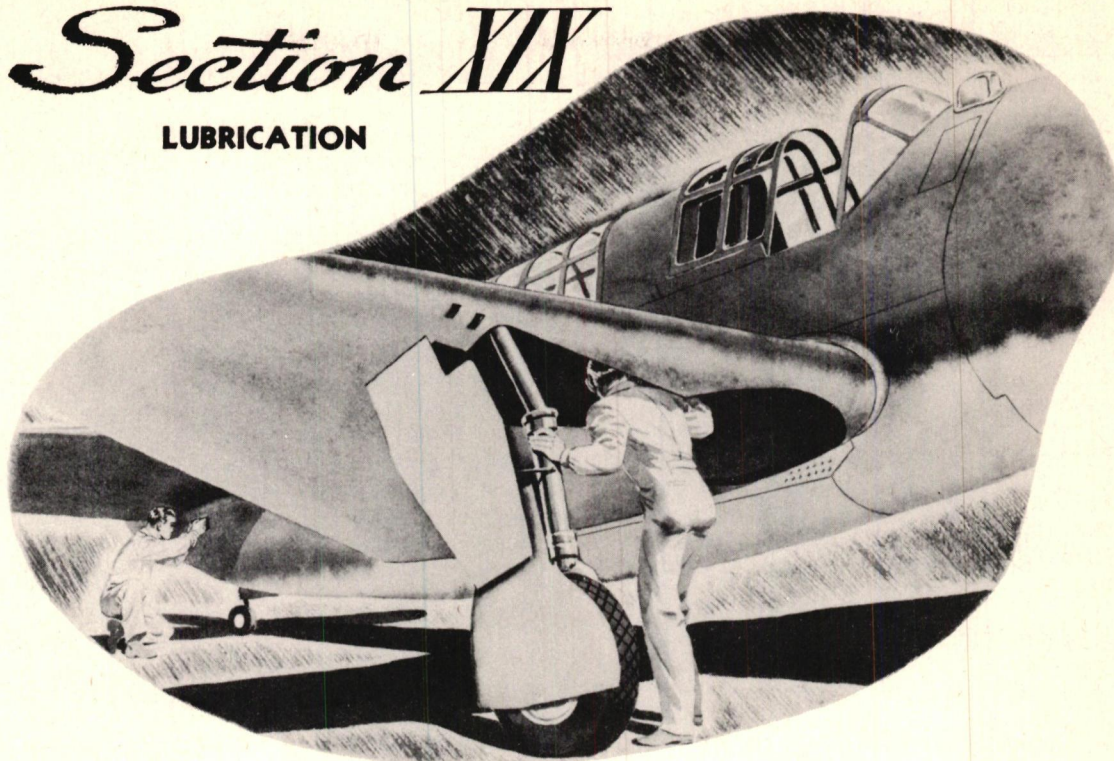
Low (discharged)	1.200 and below
Medium (partially discharged)	1.250
High (fully charged)	1.275 to 1.300

If any cell is low, or if any cell is too high, the battery is developing trouble and will be turned in to the battery room for complete inspection and repair.



Section XIX

LUBRICATION



1. Lubricants and Fluids.

Lubricants and fluids conforming to the following specifications will be used for lubrication and service of all A-25A Airplanes, as listed in part 4 of this section. Refer to fig. I-XIX for general location of items to be lubricated and serviced (except fuel tanks).

<u>Identification No.</u>	<u>Lubricant or Fluid</u>	<u>Specification*</u>
1	Hydraulic Fluid	AAF-3580, Medium Grade
1a	Hydraulic Fluid	AN-VV-O-366a
2a	Anti-Icer Fluid	AAF-14082
2b	Anti-Icer Fluid	Army 4-1018
3a	Engine Lubricating Oil	AN-VV-O-446, Grade 1100
3b	Engine Lubricating Oil	AN-VV-O-446, Grade 1120
4	Instrument Oil	Army 2-27
5	Grease, Low Temperature	AN-G-3
6	Grease, High Melting Point	AAF-3560, Soft Grade
7	Grease, Graphited	AN-G-6
8AA	Grease, Aluminum Soap	AN-G-4, Grade AA
8B	Grease, Aluminum Soap	AN-G-4, Grade B
9	Gyro Instrument Oil	AAF-3563 or AAF-3600
10	Rust Preventive Compound	AN-C-52, Grade B Type I or II
11	Lubricating Mineral Grease	Federal VV-G-681
12	Recoil Oil	Army, 2-36, Light Grade
13	Oil	AXS-777
14	Powdered Graphite, Dry	Army 2-64
15	Compass Liquid	AN-VV-C-551

*Always use material conforming to the prevailing amended or revised specification in each case. If, at any time, specified lubricants are not available, substitutes should be determined by reference to T. O. No. 06-10-4

2. Temperature Ranges.

Standard lubrication temperature ranges during which particular lubricants or fluids, or grades of lubricants or fluids (as listed in the table, part 4 of this section) will be used, are as follows:

a. **Summer Range (S).**- Summer lubrication will be employed during periods in which the normal minimum daily temperature is above -7 degrees C (20 degrees F).

b. **Winter Range (W).**- Winter lubrication will be employed during periods in which the normal minimum daily temperatures range from - 1 degree C (30 degrees F) to -29 degrees C (-20 degrees F).

c. **Extreme Cold Winterization Range (EC).**- Extreme cold lubrication will be employed during periods in which temperatures below -29 degrees C (-20 degrees F) are likely to be encountered.

NOTE: Too stiff or too heavy lubricants should be avoided more than too thin or too light lubricants. Change of grades of lubricants therefore should be made at a regular 50-hour inspection period whenever normal seasonal changes of temperature occur, giving preference to lighter grades in case of doubt. "LOW" TEMPERATURE" includes both "winter" and "extreme cold."

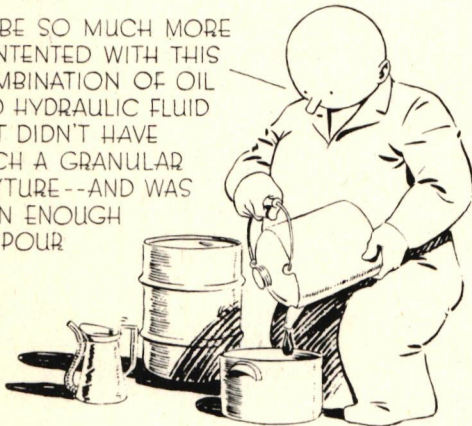
3. Handling Lubricants and Fluids.

The following precautions should be observed in handling lubricants and fluids:

a. Do not mix containers, measures, etc., used for hydraulic fluid and lubricating oil.

b. Do not allow lubricants, fluids, or containers to become contaminated with dust, dirt, grit, or other foreign matter. This is particularly important with respect to hydraulic fluid and lubricating oil.

I'D BE SO MUCH MORE
CONTENTED WITH THIS
COMBINATION OF OIL
AND HYDRAULIC FLUID
IF IT DIDN'T HAVE
SUCH A GRANULAR
TEXTURE--AND WAS
THIN ENOUGH
TO POUR



c. Keep containers closed at all times when not in use. Grease, fluid, and oil containers should never be opened for use where sand and dirt are likely to be blown into the container.

d. Wipe all pressure grease fittings before lubricating. Before lubricating parts with oil can or by wiping, remove as much dust and grit as possible.

e. After lubricating, remove any excess lubricant; it serves no useful purpose, collects dust and grit, and may cause operating difficulties under extreme cold.

f. Before using a grease gun at any period, wipe gun fitting clean, then discharge and discard a small amount of grease to remove any dirt or grit lodged in the nozzle.

4. Lubrication Instructions.

The lubricants and fluids as listed in the following table by identification numbers, referenced to part 1 of this section, will be used as noted in the table for lubrication and service of all A-25A Airplanes. Application periods established in part 1 of this section will determine the proper lubricant or fluid to be used, as listed in the corresponding temperature range columns of the table.

NOTE: In order to properly use the following lubrication chart, proceed as follows: Columns 8, 9, and 10 are headed (S) Summer, (W) Winter, (EC) Extreme Cold. Each lubricant has a number which is listed on chart in paragraph 1 of this section.

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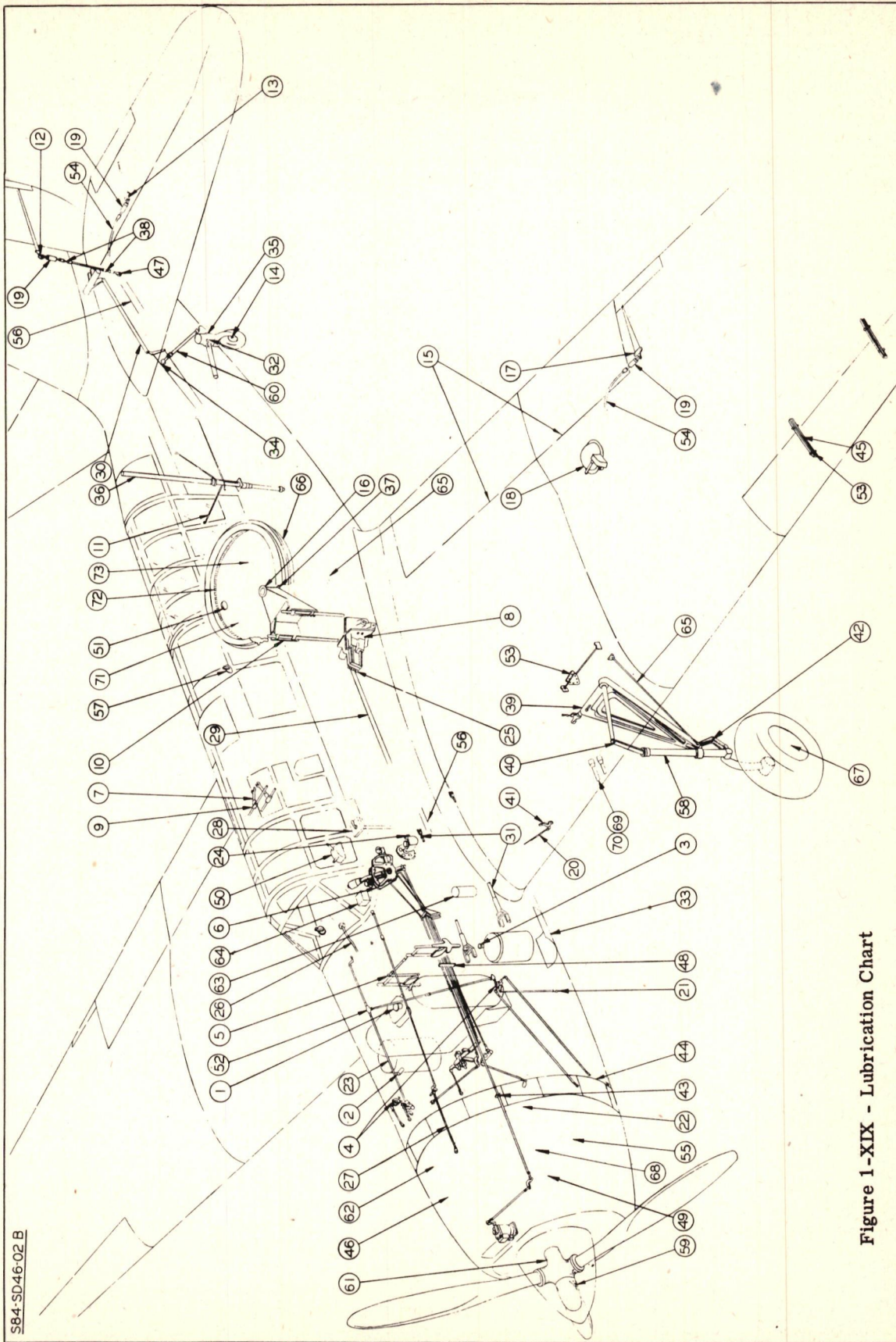


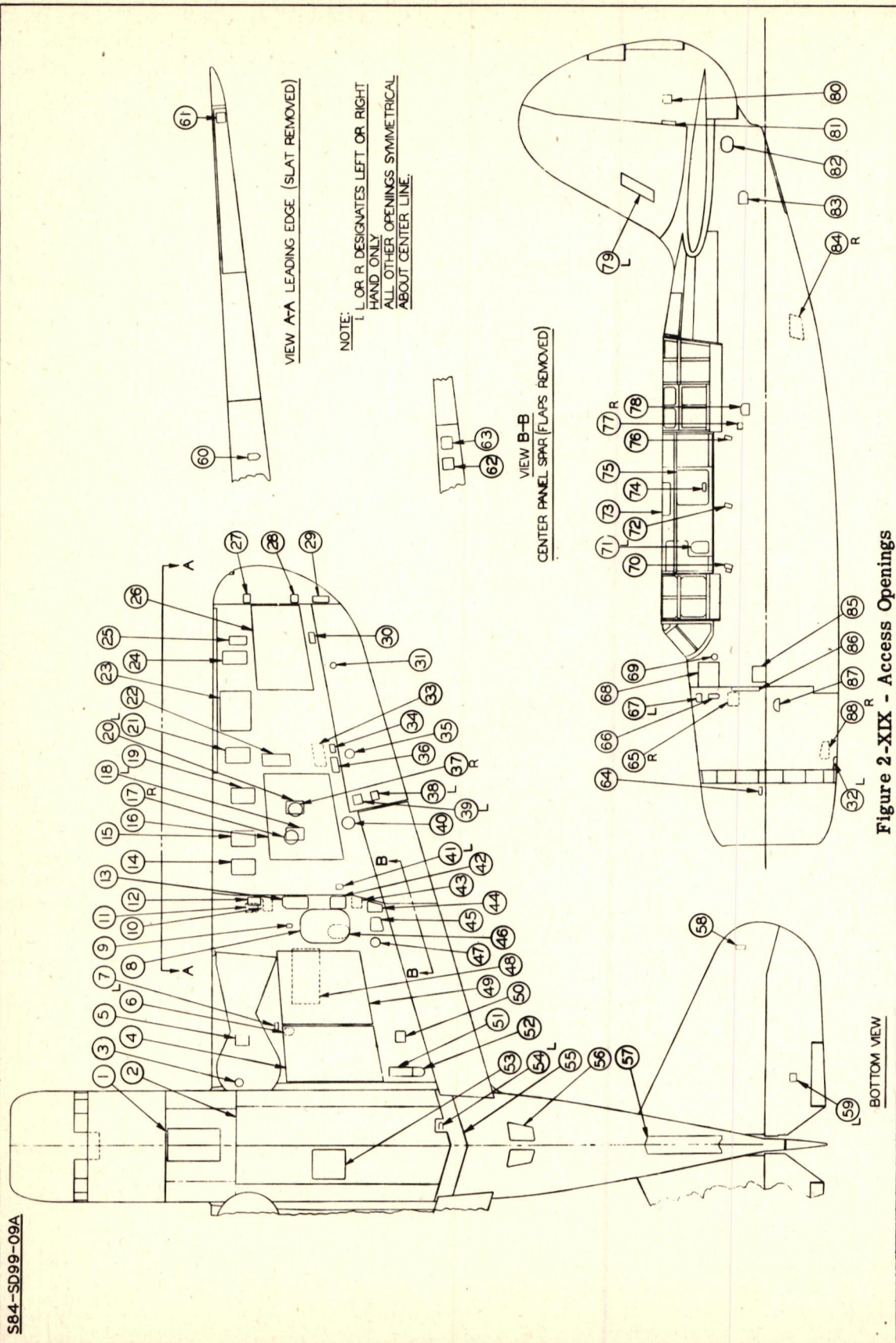
Figure 1-XIX - Lubrication Chart

Daily	Period				Dwg. Ref. No.	Item or Part	Lubricant for			Appli- cation	Remarks
	25-Hour	50-Hour	100-Hour	Special			S	W	EC		
PF					1	Oil Tank	3b	3a or 3b	3a	Hand	
*					2	Hydraulic Tank	1a	1a	1a	Hand	
PF					3	Anti-Icer Tank	-	2a or 2b	2a or 2b	Hand	
		*			4	Worm and Sector Gears, Cowland Oil Cooler Flaps	6	5	5	Hand	
	*				5	Pedal and Brake Linkage	3b	4	4	Oil Can	
	*				6	Engine Control Quadrant	3b	4	4	Oil Can	
	*				7	Flap Actuating Screws	5	5	5	Hand	
		*			8	Flap Control Gear Box	5	5	5	Zerk	
				200	9	Flap Screw Gear Box	5	5	5	Gun	
	*				10	Turret Seat Support Rollers	3b	4	4	Oil Can	
	*				11	Turtleback Retracting Linkage	3b	4	4	Oil Can	
	*				12	Rudder Tab Mechanism	3b	4	4	Oil Can	
	*				13	Elevator Tab Linkage	3b	4	4	Oil Can	
				200	14	Tail Wheel Bearing	8B	6	5	Hand	See T.O. No. 29-1-3
		*		100	15	All Continuous Hinges	14	14	14	Puff Gun	
	*				16	Turret Seat Swivel	5	5	5	Hand	
	*				17	Aileron Tab Linkage	3b	4	4	Oil Can	
		*			18	Landing Light Retracting Mechanism	5	5	5	Hand	
				*	19	Trim Tab Actuators	5	5	5	Hand	
	*				20	Landing Gear Up-Latch Linkage and Control	3b	4	4	Oil Can	
	*				21	Cowl and Oil Cooler Flap Linkage	3b	3a	4	Oil Can	
	*				22	Engine Controls (except Sealed Bearings)	3b	3a	4	Oil Can	
	*				23	Cowl Flap Control Linkage	3b	3a	4	Oil Can	

Daily	Period			Special	Dwg. Ref. No.	Item or Part	Lubricant for			Appli- cation	Remarks
	25-Hour	50-Hour	100-Hour				S	W	EC		
*					24	Tab Control Box	3b	4	4	Oil Can	See T. O. No. 05-40-10
*					25	Exterior Mechanism, Flap Motor Control Valve	4	4	4	Oil Can	
				*	26	Oil Pressure Gage Line	-	1a	1a	Gun	
*					27	Carburetor Heat Control Linkage	3b	3a	4	Oil Can	
*					28	Fuel Selector Valve Mechanism	3b	4	4	Oil Can	
*					29	Flap Position Indicator Linkage	4	4	4	Oil Can	
*					30	Elevator Push-Pull As- sembly and Linkage	3b	3a	4	Oil Can	
*					31	Bomb Displacing Gear (Ends and Bearings)	3b	3a	4	Oil Can	
*					32	Tail Wheel Lock Assembly and Linkage	3b	4	4	Oil Can	
*					33	Target Approach Door Linkage	3b	4	4	Oil Can	
*					34	Tail Wheel Shock Strut Bearings	5	5	5	Zerk	
*					35	Tail Wheel Swivel Housing	5	5	5	Zerk	
		*			36	Turtleback Support	7	7	7	Hand	
*					37	Turret Seat Lock Mechan- ism	3b	4	4	Oil Can	
				*	38	Universal Joints, Rudder Tab Torque Tube	5	5	5	Hand	
*					39	Landing Gear Lock Plunger	5	5	5	Zerk	
*					40	Landing Gear Pivot Points	5	5	5	Zerk	
*					41	Landing Gear Up-Latch	5	5	5	Hand	
*					42	Shock Strut Torque Arms	5	5	5	Zerk	
		*			43	Propeller Control Rod Fair-lead	7	7	7	Hand	

Period					Dwg. Ref. No.	Item or Part	Lubricant for			Appli- cation	Remarks
Daily	25-Hour	50-Hour	100-Hour	Special			S	W	EC		
	*				44	Cowl Flaps	3b	3a	4	Oil Can	
		*			45	Slat Track	5	5	5	Hand	
		*			46	Cam Follower Felts, Mag- neto Breaker	3b	3a	-	Oil Can	See T. O. No. 03-5DA-2 for pro- cedure.
	*				47	Torque Tube Clevis, Rud- der Control	3b	3a	4	Oil Can	
		*			48	Engine Control Fair-leads	7	7	7	Hand	
				*	49	Flexible Starter Shaft	6	5	5	Hand	
	*				50	Landing Gear and Flap Selector Valve Mechanism	4	4	4	Oil Can	
	*				51	Turret Ring Lock	4	4	4	Oil Can	
				500	52	Cowl Flap Control Gear Boxes	5	5	5	Gun	
	*				53	Slat Control Linkage	3b	3a	4	Oil Can	
				*	54	Flexible Drive Shaft, Ele- vator, and Aileron Tabs	5	5	5	Hand	
				1000	55	Generator Bearings	5	5	5	Hand	
				200	56	Chain Assembly, Rudder and Elevator Trim Tab	7	7	7	Hand	
	*				57	Hatch Controls and Rollers	3b	4	4	Oil Can	
		*			58	Landing Gear Shock Struts	1	1	1	Gun	See T. O. No. 03-25E-1
		*			59	Propeller Speed Reducer	9	9	9	Gun	Fill to opening placed 23° below horizon, 3-point position.
		*			60	Tail Gear Shock Strut	1	1	1	Gun	See T. O. No. 03-5E-1
		*			61	Propeller Hub	8AA	8AA	8AA	Zerk	See T. O. No. 03-20B-1
			*		62	Seal Chamber, Pesco En- gine-Driven Fuel Pump	11	11	11	Special	See T. O. No. 03-10EA-1 for pro- cedure.

Daily	Period				Dwg. Ref. No.	Item or Part	Lubricant for			Appli- cation	Remarks
	25-Hour	50-Hour	100-Hour	Special			S	W	EC		
			*		63	Seal Chamber, Pesco Emergency Fuel Pump	11	11	11	Special	See T. O. No. 03-10EA-1 for procedure.
			*		64	Turn and Bank Indicator	9	1/3 of 15 2/3 of 9	1/3 of 15 2/3 of 9	Special	Apply 8 drops. See T. O. No. 05-20-2
			*		65	All Cables	10	10	10	Hand	
	*				66	Turret Ring	4	4	4	Oil Can	Remove plate to oil, then replace.
			*		67	Main Wheel Bearings (Landing Gear)	8B	6	5	Hand	See T. O. No. 29-1-3
				Eng. Chg.	68	Engine Shock Mounts	8B	8B	8AA	Zerk	
			*		69	Oil Buffer, Cal. .50 Machine Guns	12	12	12	Gun or Oil Can	
			*		70	Cal. .50 Machine Guns, General Lubrication for Action	12	12	12	Oil Can or Wiping	See T. O. No. 11-1-28
			*		70	Cal. .50 Machine Guns, General Lubrication (ex- cept oil buffer), Gun Idle More than 48 Hours.	13	13	13	Oil Can or Wiping	See T. O. No. 11-1-28 Placard Airplane: "Re-lubricate all exposed portions of guns every ten days with AXS-777 oil."
			*		71	Turret Gear Boxes	5	5	5	Hand	
			*		72	Turret Ring Gear and all other Gears or Gear Seg- ments.	5	5	5	Hand	
	*				73	Ammunition Feed Chute Rollers	4	4	4	Oil Can	
			*		74	All Sealed Anti-Friction Bearings	5	5	5	Special	Do not relubricate if bearing contains AN-G-3.

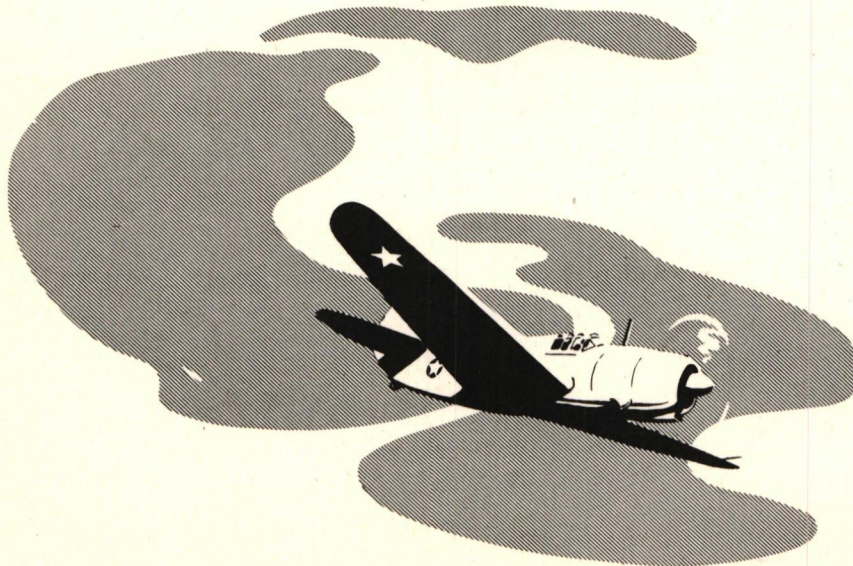


PARTS LIST - ACCESS OPENINGS

1. Target approach doors.
2. Bomb bay doors.
3. Landing gear axle nut.
4. Self-sealing tank opening.
5. Landing gear fairing attachment.
6. Cables to slat hydraulic line and to landing gear actuating cylinder locking plunger.
7. Left vent.
8. Guns and mounts, also slots for displacing of shells outboard.
9. Forward adjustment machine gun.
10. Forward attachment pin.
11. Access opening.
12. Slat cables, pulleys.
13. Wing bomb release cables.
14. Slat cable turnbuckle, forward cable.
15. Slat cables and nose ribs and formers.
16. Internal wing structures.
17. Access hole.
18. Access hole.
19. Slat cable turnbuckle, aft cable.
20. Access hole.
21. Slat cables and nose formers.
22. Access opening.
23. Slats runaround pulley - inboard.
24. Inboard side of cable and pulleys nuts to bolts in No. 22.
25. Red recognition light two bolt heads holding slat track rollers. Outboard side of slat cables and pulleys.
26. Green and amber recognition light and wires. Formation light. Conduit to wing tip junction box.
27. Junction box No. 358 and 359 access to right wing running light and to two hex nuts and bolts holding wing tips in place.
28. Amphenol fitting and conduit leading to junction box wire No. 359 to blue light and light itself on wing tip top. Nuts and bolts anchorage wing tip.
29. Castellated nut and cotter pin to aileron.
30. Four hold-down bolts to aileron support.
31. Inside of aileron.
32. Front of oil radiator.
33. Aileron actuating.
34. Five hold-down bolts to aileron support outboard aileron control tube.
35. One nut attaching aileron to support and to jackshaft.
36. Aileron bell-crank, bondings, cable ends and pulley, and bracket.
37. Right wing formers.
38. Left opening to adjust balance tabs.
39. Left inspection door for bonding.
40. Aileron cables.
41. Pilot tube drain door (Left Wing Only).
42. Bolt front wing hinge.
43. Bolt rear wing hinge.
44. Flaps and hinge bolt.
45. Gun junction box.
46. Gun solenoid.
47. Flexible drive.
48. Ammunition box doors.
49. Ammunition boxes.
50. Aileron cables, hydraulic line.
51. Drain center panel fuel tank.
52. Wing drain.
53. Access door to arm bombs.
54. Left vent.
55. Flap motors and control valve.
56. Access door to bottom of rear cockpit.
57. Tail gear cowling.

PARTS LIST - ACCESS OPENINGS

58. Hand grip on horizontal stabilizer.
59. Left door for internal inspection of stabilizer.
60. Access door to landing gear hinge pin.
61. Blue recognition light disconnect.
62. Bore end of machine gun opening.
63. Bore end of machine gun opening.
64. Openings to fasten cowlings.
65. Right access door to fill hydraulic tank.
66. Engine mount attachment.
67. Left access door to fill oil tank.
68. Access door to get behind instrument panel.
69. Opening for tricing.
70. Hand grip.
71. Left fuselage tank filler neck.
72. Hand grip.
73. Opening for stationary hatch.
74. Handle to life raft compartment.
75. Life raft compartment.
76. Hand grip.
77. Right ventilation door.
78. Step on fuselage near gunners cockpit.
79. Left compass transmitter.
80. Left openings for trim tab adjustments.
81. Opening for trim tab adjustments.
82. Electrical connection running through tube to rudder.
83. Micro switch for tail gear. Bell crank for horizontal stabilizer.
84. Right ammunition dump.
85. Right accumulator and bracket.
86. Nacelle opening - fire wall.
87. Foot step in side of cowlings.
88. Right access door for manual starting.



Section XX

CREW CHIEF DUTIES



1. Responsibilities.

The crew chief is charged with the responsibility of performing technical inspections and maintenance of aircraft in accordance with policies and instructions prescribed in Army Air Force regulations, Air Corp circulars, Technical Orders, etc., and by organization engineering officers. His duties in general are as follows:

- a. Service, inspect, and maintain assigned aircraft and aircraft equipment.
- b. Maintain the prescribed aircraft maintenance inspection records and reports.
- c. Instruct mechanics (assistants) under his jurisdiction in the prescribed standards of workmanship, inspection, and maintenance.
- d. Assist the pilot in becoming familiar with pertinent data on the status and functioning of assigned aircraft.
- e. Submit recommendations with respect to improving the efficiency of maintenance and inspection.
- f. When required, to accompany the aircraft on flights and if designated by the pilot, to service, inspect, and maintain the aircraft while away from the home station.

The qualifications of a crew chief include, therefore, a thorough knowledge of the type of airplane to which he is assigned, plus the ability to compile and maintain statistical records concerning his specific airplane.

An adequate comprehension of the following Army Air Force Forms is necessary:

<u>Form No.</u>	<u>Name</u>
1	Flight Reports, Operations
1A	Flight Reports, Engineering
41B	Maintenance Inspection Record
60A	Technical Instruction Compliance Record (Aircraft)
60B	Technical Instruction Compliance Record (Engine)
61	Propeller Historical Record

2. Flight Reports, Engineering, and Operation.

Form 1 and 1A are stowed in the data case in the cockpit of the airplane at all times. The purpose of Form 1 is to convey to Operations Officers a record of each flight in an airplane or time in an instrument flying trainer. The information contained in this form is used in the preparation of training records, etc.

The purpose of "Flight Report Engineering" (Form No. 1A) is to provide the pilot before take-off with pertinent data relative to the servicing, inspection, and maintenance status of the airplane; to provide a convenient means of recording data that will later be transcribed to Form 41B; and, by means of the stub, to provide the Materiel Center with the statistical data compiled thereon.

While these forms are used by all personnel involved in the flight of the aircraft, it is the crew chief's responsibility to perform the following:

a. Ascertain that a pad of Forms 1 and 1A, together with a sharpened pencil, are always in the holder in the cockpit of the airplane.

b. To bring any mechanical defect or delinquent inspection to the attention of the pilot before take-off.

c. Since certain information in one day's "Flight Reports" will be needed to complete the "Flight Report" of the next day following, it will be necessary to prepare a new set of "Flight Reports" whenever any one of the following operations has been accomplished:

(1) When the last flight of the day and all necessary inspections, maintenance, and servicing has been completed.

(2) When oil is changed before the last flight of the day. In this case, new forms are necessary so that the entry "Oil Change Due" on Form 1A will show correct engine hours.

NOTE: This condition will never occur on the A-25A Airplane, since it is equipped with a hopper-type oil tank and oil is not changed between engine changes. The condition is included here, only as a matter of general information.

(3) Whenever regular 25-hour, 50-hour, or 100-hour inspections are completed during the day.

d. After the new sets of forms have been prepared, transcribe all the data to Form 41B, and forward Form No. 1 to the Operations Office and Form No. 1A, with its attached stub, to the Engineering Office.

A set of symbols has been devised to simplify the recording of certain information. It has been found that six of them, sometimes augmented by supplementary remarks, cover every phase or situation that normally will be encountered.

A red cross (x) is used to indicate a dangerous condition. The appearance of this symbol on the report, grounds the airplane and, until the condition of which it warns is corrected, the airplane will remain grounded. It is used, whenever a defect exists in any system, part, or assembly which renders the airplane unsafe for flight or whenever unaccomplished, or partially unaccomplished maintenance work makes flight hazardous. Unsafe conditions, which are perfectly obvious need not be recorded by the airplane mechanic. However, if removal of parts or assemblies is not readily apparent and the mechanic leaves the immediate vicinity of the airplane for any reason, this symbol must be inserted in its appropriate column of the form. Airplanes thus grounded will not be released for flight until the completed work has been certified by some responsible authority. This person will indicate by appropriate remarks over his signature on Form 1A, that the repairs have been made to his complete satisfaction.

A red diagonal line (/) indicates the existence of minor unsatisfactory conditions which are not serious enough to render the ship unsafe for flight. Airplanes in this condition may be flown, provided it is released for flight by the execution of an "exceptional release."

It is not necessary to insert this symbol on Form 1A as long as the mechanic remains in the vicinity of the aircraft, or when the defect is obvious. In any other case, however, the insertion of this symbol in its appropriate column is mandatory.

A red dash (-) shows that a "required inspection is not made." It does not ground the ship but the execution of an "exceptional release" must be made before it can be flown.

The fourth symbol consists simply of the last initial of the mechanic who performs the work. Its appearance on Form 1A, shows that the parts affected have been thoroughly inspected and found satisfactory, except that in the three columns which cover preflight and daily inspections, the symbol indicates only that the inspection has been made.

When this symbol (the mechanic's initial) is placed over a red symbol, it indicates that corrective measures have been taken to remedy the unsatisfactory condition. For this reason, a red symbol is never placed over a black symbol. Instead, whenever defects are discovered after the entry of the encircled initial, the symbol is erased and another and appropriate symbol is inserted in its place. Erasures are not made in the "Status Today" columns, since, in this case, the defect can be indicated in the next open symbol column.

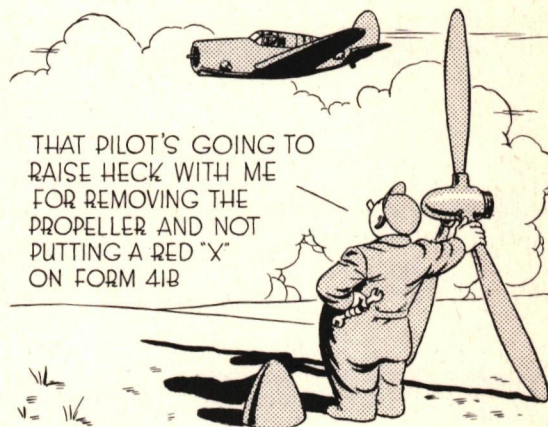
A black circle (o) around the last-name initial of the worker indicates "greased or oiled" except that when appearing in column 46, "Batteries" it indicates a routine addition of water to the batteries.

NOTE: This symbol is not used to indicate the addition of oil to the engine, nor for any purpose other than those listed in the preceding paragraph.

The most common use of the black dash (-) is to indicate that a "daily inspection" is not required, if such is the case. Specifically it means that "inspection today is not required by technical instructions."

The vertical black line (|) drawn through any space indicates that this column is not applicable to the particular airplane which this form covers. For instance, the spaces allocated to Nos. 2, 3, and 4 oil tanks, radiators or Nos. 2, 3, and 4 engines will never be applicable to an A-25A Airplane since this airplane has but one aircooled engine, and these columns will be so marked.

When any of these symbols appear on a flight report they represent the best opinion of the mechanic making the repair or performing the inspection. They will not be changed or altered except by higher authority, who will indicate his reasons for making the change over his signature, in column 47 of Form 41B.



In addition to the six symbols which the Crew Chief actually uses, an understanding of other symbols, which will appear principally on Form 1A, is also required. These are listed on the inside of the front cover of the pad of Forms 1 and 1A.

Flight Report - Engineering (Form No. 1A) and Flight Report - Operations (Form No. 1) are bound together in a booklet form. A supply of these pads remains in the data case of the airplane at all times. They are the means by which information is conveyed to the proper offices for records and analysis.

In considering the first of these, Flight Reports - Engineering, it should be noted that the posting of correct and exact information is essential to the safe and economical maintenance of the ship, and to the safety of the personnel who will use it. For this reason, it is designed to contain all of the information necessary, pertinent to the operation of the airplane, which personnel, involved in its handling, will need in any one day.

In the upper left-hand corner, a section is set aside to show the exact situation that exists with respect to the airplanes inspection status. Individual lines are provided for each type of regular inspection, with two lines left blank so that special or unusual inspections may be properly inserted. The entries under "Preflight" and "Daily" will show the date of the last inspection of these classes. If none are made on the current date, a red dash will be inserted. Opposite the inspections based on hourly periods, insert the airplane hours when the next inspection of each type will be made. The next two columns "by" and "station" are used whenever the inspections are made at a point remote from the hangar or away from the home station.

Directly below this section is another of similar size and shape with the heading "Inspection of Auxiliary Equipment." This section is properly filled in by specialists and the Crew Chief's only concern is to see that this is done.

Further below this section, is the space reserved for "Remarks: Pilot's and Mechanics." It forms the bulk of the lower half of the form and is used by the Crew Chief to record the necessary explanation of the symbols which have been used in other parts of this form, and to note specific information for which no regular space is provided. This space is used by other personnel in the performance of their duties and this should be kept in mind so that all entries herein are kept as short and concise as possible.

Records of servicing the airplane with fuel and oil is made in the section at the upper right-hand corner of the form. The fact that more than one servicing may be made in one day is taken into consideration and five lines are provided for initial and subsequent replenishment of fuel and oil. Under "Fuel," columns are provided to show the gallonage issued and the total amount, in gallons, of fuel stored in the tanks. Issues of oil are similarly recorded in their particular spaces.

NOTE: Crew Chiefs assigned to A-25A Airplanes will mark a straight vertical line through the columns set aside for the No. 2, 3, and 4 oil tanks and for the "radiator check."

Under the heading "Status for Today" enter the appropriate symbol. If a red symbol is used an explanation must be given in the space provided for it on the form. As previously explained, the "Exceptional Release" must be signed by the authority permitting the ship to be flown, despite the red diagonal symbol.

The "Aircraft and Engine Time Record" is used as follows:

(a) Under "Hours to Date" insert the total number of hours since the last overhaul of the engine; likewise, the same information for the airplane will be inserted in the space provided for this purpose.

(b) The "Hours Today" is the total time for the current day spent in actual flight. This information is obtained from Form 1.

(c) The "Total" is the sum of these two figures and for convenience, should be immediately entered on the Flight Report - Engineering form which will be used on the next succeeding day.

NOTE: The spaces under "Engine Oil Change Due" and "Cuno Cleaning Due" will be disregarded in the case of the A-25A Airplane.

The stub, attached to the bottom of this form, will also be filled in by the Crew Chief before he gives the completed report to the Engineering Office. All of the statistical data will have been notated from the previous day's Flight Report, except the "Total Flight Time" which can be obtained from the body of the form itself, under "Aircraft and Engine Time Record."

The heading of Form 1, Flight Report - Operations, is also filled in by the Crew Chief. If this information is posted on succeeding forms as each day's flights are completed, this matter will become routine and easily accomplished, since the statistical information used, need be obtained from the Engineering and Flight Offices at infrequent intervals.

At the completion of the day's flying, this form will be forwarded to the Operations Office.

3. Maintenance Inspection Record.

The Maintenance Inspection Record is available in two forms. Form No. 41 takes the form of a large chart; Form 41B is arranged in pamphlet form. The information posted to each is identical and so, for convenience, the following paragraphs are arranged with the Pamphlet Form (41B) as the example used.

The first page of the pamphlet is designated as the "Maintenance Inspection Record." It contains all the statistical data pertinent to the airplane, whose history it records, and the names and identifying data of the personnel involved in its maintenance. If changes are made which affect the fuel and oil capacity of the airplane, this information should be recorded immediately. When a new crew chief or assistant is assigned, his name should be added to the form. The name of the relieved man is never erased from this record.

The second page, known as the "Inspection Schedule," is used to schedule inspections. Space is provided for recording and scheduling all regular inspection, as well as special inspections of accessory equipment.

The Maintenance Inspection Record, twenty-three lines high, is divided and sub-divided into 54 major columns. Some of these columns are further divided into smaller units to accommodate multi-engined airplanes. The record of the A-25A Airplane will utilize only the first of these smaller units and a vertical line will be drawn through the remaining three.

The airplane "Time Today" and "Total Time" are posted in columns 1 and 2, respectively. The "Time Today" is the total time flown on any one day and the "Total Time" is the day-to-day accumulations since the last major airplane inspection.

Defects reported by the pilot are notated in column 3, and the pilot's name in column 4. If more than one pilot has flown the plane, each man's name will be recorded.

Column 5 is used to record the total amount of oil, in quarts, which the airplane has used during any one day. Columns 6, 7, and 8 are used to record oil issues of multiple-engine planes and will not be used in connection with the A-25A Airplane. Instead, a black vertical line will be drawn through them.

NOTE: Oil changes are usually identified by drawing a line under the figure representing the total issue of oil. This will never apply to the A-25A Airplane, since oil is never changed on aircraft equipped with hopper-type oil tanks.

The pre-flight inspection status of the airplane is noted in column 10. Ordinarily, the last-name initial of the mechanic who made the inspection will indicate that it has been completed. However, in the event that it was not made, the symbol for "Required Inspection not Made," a red dash, will be inserted. Whenever this last-named condition occurs the "exceptional release" will be executed, either on this form (41B) or on the Flight Report - Engineering (1A). If made on Form 1A, the name of the person making the release is copied to this form and a notation is made in column 47 (of form 41B) stating that the original execution was made on the Flight Report (1A).

The data, recorded in columns 11 to 17, is posted from the Flight Report - Engineering form. This report will show which items of auxiliary equipment were inspected and the name of the specialist who made the inspection. Ordinarily, this man will not be identified or listed on the Maintenance Inspection Record at the front of this form. Therefore, his name will be shown in column 47, under "Remarks."

Columns 19 and 30 are handled in the same way as column 10, except that these two columns refer to the "Daily Inspection." It is used to indicate, simply, that the daily inspection was performed, was not performed, or was only partially performed. The appropriate symbols covering any of these contingencies is inserted in the line for the current day and also is immediately inserted in the next line following, if it is one of the red symbols. Symbols indicating the results of the inspection, or work done, are entered in one of the columns 20 to 29, and 31 to 46.

Columns headed 48 and 49 - there are three sets of them - show the "Status Today." This information is compiled from the information shown on the Flight Report - Engineering. "Exceptional Releases" will be handled as outlined in the foregoing.

Columns 50 to 54 are reserved for the initials of the supervisory organization, who personally insert them after they are satisfied that inspections and maintenance are being carried out satisfactorily and economically, as planned.

All that has preceded this point, covered, with few exceptions, only the proper information to be inserted in each column. A definite method, utilizing the six symbols, which have previously been explained in conjunction with these forms needs further amplification. For the sake of clarity, some repetition of previous remarks will be made in that which follows.

a. Under "Daily Inspection" (Columns 19 and 30).-

(1) If, during inspection, it is found that defects exist or that maintenance work is required, the appropriate symbol is entered in one or more of columns 20 to 29, and 31 to 46.

(2) If a daily inspection is not required, the black dash symbol for "Inspection today not required" is entered, except that an entire line of the form is not used solely for this purpose.

(3) If, though required by existing instructions, the daily inspection is not made, the red dash symbol for "Required inspection not made" is entered, except that an entire line of the form is not used solely for this purpose.

(4) The black dash or the red dash is never entered in any column unless there are other entries on the same line in some other section.

(5) A red "x" is entered in column 19 whenever an airplane is out of commission because the engine is being changed. This red cross is "cleared" in the conventional manner by the mechanic, who completes the change, placing his initial over the red "x."

b. Under "Batteries" (Column 46).-

(1) There are two batteries in the A-25A Airplane. Data pertaining to the forward battery may be entered in the upper part of this space and data pertaining to the aft battery may be entered in the lower portion.

(2) A circle is placed around the surname initial of the mechanic who adds water to the battery.

(3) If the gravity is taken, place the reading of the lowest cell in the circle around the mechanic's surname initial.

c. Under "Remarks" (Column 47).-

(1) Whenever a symbol appears in any one of columns 19 to 46, indicating a dangerous condition, a defect, or that a defect is removed, the remaining defects are reentered in the remarks column, each entry so handled being preceded by the column number to which it pertains.

(2) Remarks are also entered to explain symbols recording the accomplishment of one-time changes, modifications, inspections, etc., directed by Technical Orders.

(3) When any data, not specifically recorded in any other section of the form, is applicable to the airplane, it is recorded in this column.

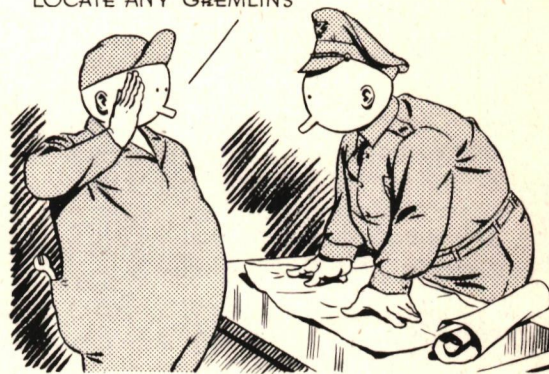
(4) Remarks explaining maintenance delays, caused by lack of spares and supplies, are notated herein.

(5) Compliance with Technical Orders are posted herein, by stating, "Technical Order (No.) complied with."

(6) Whenever a defect, reported by a pilot, cannot be located or appears to have been reported in error, an appropriate remark is entered to that effect.

NOTE: The fact that no corrective action can be taken is reported to the engineering officer.

I WISH TO REPORT SIR THAT I COULDN'T
LOCATE ANY GREMLINS



(7) Whenever an individual changes another's symbol, he places the reason for his action in this column.

(8) Whenever an airplane is involved in an accident or forced landing, brief remarks showing the cause, if known, and the extent of the damage, will be made in column 47.

d. Horizontal Lines.-

(1) One line, across the entire form, is used for each date on which:

- (a) The airplane is flown.
- (b) The airplane is serviced with fuel or oil.
- (c) Inspection or maintenance work is accomplished.
- (d) Entries are made in column 47.
- (e) An entry is made in the section "Inspection Record."

(2) On the line preceding the first entry of each new month, enter the name of that month in column 3. Thus, the separate months will be indicated by a blank line, throughout the entire form.

(3) Each time a horizontal line is used for an entry in any column of the form, the current date is entered on the line used, in the "Date" column to the left of each section of the form; except, on the day the status of the airplane is recorded in column 48 on the next lower horizontal line, A DATE IS NOT ASSIGNED TO THAT LINE UNTIL SOME OTHER ENTRY IS MADE THEREON.

(4) A date once entered on any line, assigns that line to that date throughout the entire form. Since it will frequently happen that an entry will be made in only one column of a line, care must be taken to avoid over-lapping of dates.

(5) Whenever an entry is made on a horizontal line, other than the status entry required to be made at the end of the day on the next lower line, the following additional data are entered, or brought forward, from the preceding line:

- (a) The status of the daily inspection.
- (b) All uncleared red symbols.

(6) If the columnar space in any column is insufficient, the entry may be completed on the next lower line; in which case the two lines are bracketed to indicate that they pertain to but one date.

(1) Form 41B is retained in the Engineering Office only when the airplane remains at one point for any appreciable length of time. Otherwise, it is carried in the data case of the airplane.

f. Entries on New Forms.- When starting a new form, the following entries will be transcribed from the last previous form:

- (1) All identification and data records under the title "Maintenance Inspection Record."
- (2) In columns provided for engine and airplane inspections, enter the airplane hours the next inspection will be due.
- (3) Enter routine inspections due at periods in excess of 400 hours. Also enter any added inspection periods not provided for in other columns.
- (4) Enter total time flown on the current date in the "Time Today" column.
- (5) Carry forward to the new form the accumulation of total time, and post it in column 2.
- (6) The month the new form was started is entered in column 3.
- (7) Under "Time of Accessory Equipment" enter the name of the specific accessory and airplane hours installed for all accessories on which a time record is being maintained.
- (8) Under "Remarks," copy whatever miscellaneous data is desired to be brought forward from the old form.
- (9) Transcribe on line 1 of the new form every entry from the last line of the previous form.

Forms 60A, 60B, and 61 are normally kept in a pocket, which is incorporated in the back cover of Form 41B. They are supplementary to the Maintenance Inspection Record and are necessary to complete the history of the airplane.

a. Technical Instruction Compliance Records.- Form 60A and 60B are similar, except that one covers the aircraft itself, while the other is used to record data pertaining to the engine of that aircraft. Both forms are records of compliance with technical orders.

- (1) Aircraft. - The heading of Form 60A is a compilation of statistical data, pertinent to the aircraft which it covers. The information needed to complete it should be self-evident, or readily obtainable from the Engineering Office, the airplane itself, Form 41B, etc.

The body of the space of the form is divided into columns, as listed to the left below. Information will be posted in these columns, according to the directions opposite each column title, below:

- (a) Date a. Insert the date that the Technical Order was received.
- (b) Number b. Insert the Technical Order Number.

- | | |
|---|---|
| (c) Title | c. Insert the title of Technical Order. |
| (d) Locally, Immediately
Soon as possible
Soon as practicable | d. Show the time of compliance, as directed by the Technical Order. |
| (e) Form 55 Required | e. This is the "Technical Order Compliance Report." If the T. O. requires it, insert an asterisk in this column. |
| (f) Date Completed | f. This information will be entered by the inspector of the unit which does the work. |
| (g) Inspector | g. The inspector inserts his initials in this column. |
| (h) Engineering Officer | h. Signing of the Engineering Officer's initials indicates his approval of the completed work. |
| (i) Organization | i. The name of the organization that does the work need not be shown unless the work was done by an organization other than that of the aircraft. |

The obverse side of this form is designed to show an up-to-date record of the various engines that have been installed in the airplane at various times. It shows the name, model number, and the Air Corp or serial number. By listing the dates and the airplane flying time in the appropriate columns, accurate compilation of the flying time of the engine is obtained.

Under "Record of Transfers" will be found a concise history of the airplane's service. The captions of the various columns need no explanation as they are self-explanatory, and the information, which is inserted therein, is readily apparent.

b. Engine. - Form 60B differs from 60A, only on the obverse side of the form. The general arrangement is the same, but "associate equipment" is meant to be only those units and assemblies which normally are removable with the engine. When engines are removed and sent to another location, this form is sent with the engine.

c. Propeller Historical Records. - The purpose of this form is to provide a historical record of controllable propellers. This form is prepared for each new propeller and remains with it throughout its entire life. Filling out the face of the form is accomplished as follows:

- | | |
|--|--|
| (1) Heading. | (1) The required data are self-evident. |
| (2) Station and date | (2) The name of the station performing the operation is inserted on the upper line, the date on the lower. |
| (3) Identification | (3) Air Corps serial number or, if this is not available, the manufacturer's serial number of the hub and each blade is inserted. |
| (4) Total propeller hours at installation. | (4) This is the life of the propeller, expressed in hours of flying time. It is obtained by subtracting the airplane hours at installation from the airplane hours at removal and adding the difference to the total propeller hours at installation shown in the preceding entry. |
| (5) Installed | (5) Show the engine airplane model and serial numbers and also the airplane hours at installation. |
| (6) Removed | (6) The name of the station at which the removal takes place and the date at which it occurs is placed in the appropriate column and the airplane hours at removal of the propeller is inserted in its space. |

(7) Propeller hours since last overhaul.

(7) Insert the life of each blade and the hub expressed in hours.

NOTE: When a propeller is given a general overhaul, all columns under the heading "Installed" and "Removed" are ignored and "General Overhaul" is entered across all columns. Under "Station and Date," "Identification," and "Propeller Hours at Installation," the instructions given above apply.

The reverse side of this form is used for recording explanations of action taken, of which only an indication can be given on the face of the form.

5. Aircraft Checker's Report (Forms 263 and 263A).

a. General. - The "Aircraft Checker's Report" was originally identified as Form No. 263. It consists of a list of items of equipment shipped loose and items easily removable without affecting the flying qualities of the aircraft. The items are divided into logical groups and provision is made at the end of each group for the signatures of the checkers at the shipping and receiving stations.

Provision for the signature of the shipping officer and the receiving officer is likewise incorporated. The signature of the receiving officer is made on a receipt form which is removed and retained by the ferry pilot as his personal receipt.

This type of "Aircraft Checker's Report" was being used when the first few A-25A Airplanes left the factory. Form 263A, which is being used at present, will eventually be extended to cover these first airplanes, according to AAF Regulation No. 15-263, dated April 15, 1943, which states: "This form (263) will continue to be used by the Air Service Command for aircraft already delivered from complete contracts where the status and quantity of the model does not justify preparation of this new form." This regulation further states that "should Form No. 263A be made available for aircraft currently covered by Form No. 263, all stocks of Form 263 for those aircraft will be destroyed."

Because the use of Form 263 was limited and often uselessly troublesome, the newer Form 263A was devised. It incorporates all of the desirable features of the original form, while simplifying their accomplishment. Besides this, the revised form is arranged so that it conveys certain desirable information to other commands beside the Air Service Command.

Specifically, Form No. 263A was developed for the following purposes:

(1) To eliminate separate compilations of Aircraft Checker's Report and Contractor's Packing Sheets.

(2) To provide an accurate and exact check list of equipment necessary for each individual aircraft, operationally and tactically complete, rather than a check list for large groups of aircraft.

(3) To provide a "log book" of complete data on all permanent changes and modifications throughout the life of the aircraft.

(4) To provide a means for the eventual elimination of certain of the various forms and data sheets, formerly required to be kept in aircraft.

NOTE: Form No. 263A will remain in the data case of the aircraft at all times. It will not be withdrawn for the files of any activity.

b. Description of Part I. - Part I of Form No. 263A consists of the following, in order:

(1) An instruction sheet, giving a resume of the information contained in regulation No. 25-263 for the use of personnel not having access to a copy of the regulation. The instruction sheet will be the first page of part I.

(2) A contractor's data sheet, used by the aircraft prime contractor for the entering of any data necessary for his own records.

(3) An equipment list, compiled by the prime contractor to show all items necessary for a complete aircraft as required by the contract. The layout of the equipment list is based upon a graphic division of the aircraft into groups of items corresponding to the sections indicated upon a diagram of the aircraft. Items within each section are listed as nearly as possible in orderly sequence corresponding to their relative location within that particular section. A diagram on the first page illustrates and explains the sectional breakdown applicable to the aircraft. The column heading and codes used on the equipment list are as follows:

(a) Column 1, headed "Item No.," lists items of equipment in numerical sequence as an aid in referring to any specific piece of equipment.

(b) Column 2, headed "Status," contains code letters indicating the following meanings:

1. "C" - Government-furnished equipment installed by the contractor.
2. "S" - Miscellaneous government-furnished equipment installed by the Government.
3. "N" - Equipment furnished and installed by the contractor.
4. "NX" - Non-expendable items to be accounted for on memorandum receipt.

(c) Column 3, headed "C," identifies by asterisks those items of equipment whose physical presence is to be checked by service activities. Items having no asterisk in this column are shown for the use of certain other activities requiring complete data and will not be checked by service activities.

(d) Column 4, headed "Nomenclature," is self-explanatory.

(e) Column 5, headed "Part Number or AAF Stock Number," will contain the AAF stock number as described in T. O. No. 00-35A-8 for items using the manufacturer's or government's part number as a part of the stock number. Other items will be identified by part number or catalog number.

(f) Columns 6 and 7, headed "Req. in Sec." (Required in Section) and "Total Required" (per aircraft), are self-explanatory.

(g) Column 8, headed "Installation Drawing," will contain the number of the aircraft contractor's drawing showing location and mounting or attaching details for the item.

(h) Column 9, headed "Remarks," will contain any additional information available which would aid the checker in his work. Items supplied by arms or services other than the Army Air Forces will be so indicated in this column.

(i) Additional items may be added when necessary in the blank lines at the end of each group.

c. Use and Accomplishment at the Factory.-

(1) When an aircraft is accepted from the contractor, one copy of a completed Form No. 263A consisting of parts 1 to 6 inclusive, bound in a loose-leaf binder plainly marked with the model and AAF serial number of the aircraft to which it pertains, will be forwarded with the aircraft. The data thus forwarded will form the basic part of a lifetime log of equipment installations, removals, and modifications performed on that particular aircraft.

(2) Items entered by the contractor in Form No. 263A will indicate the equipment intended to be installed as contractual requirements before acceptance by the government. All items will be listed, even though temporary unavailability of some equipment results in acceptance of the aircraft minus certain items.

(3) Part 2 will contain the prime contractor's record of all contract changes, including other changes made by him tending to distinguish the aircraft from other aircraft of the same model.

(4) Part 3 will contain the prime contractor's record of Technical Orders complied with at this plant.

(5) Part 4 will contain the prime contractor's record of Technical Orders not complied with at this plant.

(6) Part 5 will list all equipment shortages existing at the time of acceptance of the aircraft by the Army Air Forces.

(7) Part 6 will have the portion of the delivery receipt covering transfer from the shipping officer (AAF resident representative) to the ferry pilot accomplished at the prime contractor's plant.

d. Use and Accomplishment by Modification Centers.-

(1) Upon receipt of the aircraft by the modification center, the "Receipt for Ferry Pilot" incorporated in part 6 of Form No. 263A will be accomplished and returned to the ferry pilot.

(2) Part 1 of Form No. 263A will be used by the modification center as a check list in determining shortages. Items listed in parts 2 and 3 lending themselves to loss or easy removal will be checked for in the same manner as the items listed in part 1.

(3) The blank spaces in the headings of parts 7 to 10, inclusive, will be filled to show page number, aircraft model and serial number, modification center contract number, and the name and location of the modification center. Each part will have its pages numbered separately, beginning each part with page number 1.

(4) Part 7 (work to be accomplished by the modification center) will be accomplished as follows:

(a) All work required to be accomplished will be entered in the column headed "Description of Work" upon arrival of the aircraft at the modification center. Entries will be divided into the following divisions:

1. Government-furnished equipment to be installed.
2. Contractor-furnished equipment to be installed.
3. Other work to be accomplished.

(b) The part numbers and AAF or commercial type or model designation, if any, will be entered as a part of the description of the work.

(c) Items not of AAF issue will have the supplying arms or service indicated in the "Remarks" column; for example: "Signal Corps Item," "Ordnance Item," etc.

(d) Work completed at the modification center will be indicated as follows:

1. Part or all of the first page of part 7 may be used by the modification center as a general purpose data sheet to show any data not provided for in the regular column headings.

2. Entries made as prescribed in paragraph d(4)(a) above, will be lined out, and the note "Accomplished at Modification Center" will be entered in the "Remarks" column.

3. To insure that items installed at the modification center will be readily found during later checks of the aircraft, column 1, "Section in Which Installed," will be filled in. The correct section number will be determined by reference to the sectional breakdown diagram shown in the heading of part 1 (Equipment List). If the newly installed item is loose, i.e., not attached to the aircraft structure, notation will be made in the "Remarks" column as to the exact place of stowage.

(e) Work listed as prescribed in paragraph d(4)(a) above, but which remains unac-

completed at time of departure from the modification center will not be lined out. The reason for nonaccomplishment and authority for release from the modification center with the shortage unfilled will be noted in the "Remarks" column. In the event of partial accomplishment, the entry will not be lined out, but the extent of work actually performed will be indicated in the "Remarks" column. For example, if the original entry is "Install SCR 535 radio," the "Remarks" column might contain the entry "Mounting provisions only installed."

(5) Part 8 (Technical Orders Complied with by Modification Center) will be accomplished as follows:

(a) The number and title of each Technical Order complied with will be listed. Any other pertinent entry will be listed in the "Remarks" column. In the event of partial completion of work specified in a Technical Order, the "Remarks" column will indicate what portion of the work was actually completed.

(b) Before the beginning of Technical Order compliances by the modification center, part 3 (Technical Orders Complied with at Prime Contractor's Plant) will be reviewed in order to avoid duplication of effort.

(c) Before departure of the aircraft from the modification center, part 4 (Technical Orders Not Complied with at Prime Contractor's Plant) will be reviewed and Technical Orders listed therein which have been accomplished at the modification center will have the entry "Accomplished at Modification Center" entered in the "Remarks" column of part 4.

(6) Part 9 (Technical Orders Not Complied with at Modification Center) will be completed to indicate the numbers, titles, reasons for noncompliance, and authority for release from the modification center without compliance for each Technical Order not accomplished by the modification center. Part 9 will include Technical Order listed in part 4 which remains unaccomplished by the modification center.

(7) Part 10 (Shortages at Time of Departure from Modification Center) will be accomplished in the following manner.

(a) All shortages of required equipment existing at the time of departure from the modification center will be listed. Shortages listed in part 5 (Prime Contractor's Shortages List) which have not been made up at the modification center will be carried forward and entered in part 10. Part 5 will then have substantially the following written across each page in a conspicuous location: "Superseded by part 10, Modification Center Shortage List."

(b) Shortages brought forward from part 5 will be listed in a separate group from those for which the modification center is responsible. Each of these will in turn be divided into separate groupings for contractor-furnished equipment and government-furnished equipment.

(c) The complete nomenclature of the item will be entered in column 1 of part 10, including the AAF commercial type or model designation, if any.

(d) The part number or AAF stock number of the item will be entered in column 2.

(e) The quantity short, i.e., the number lacking to fill the aircraft's full complement of the item, will be entered in column 3.

(f) In column 4 will be entered the reason for the shortage and authority for release from the modification center with the shortage unfilled.

(g) In addition to any other required distribution of part 10, the provisions of AAF Regulation No. 65-47, "Responsibility for Fully Equipping Aircraft for Combat Operations" will be strictly complied with.

(8) Part II (Delivery Receipt from Modification Center) will be accomplished at the time of the aircraft's departure from the modification center.

(9) Properly accomplished copies of parts 7 to 11, inclusive, will take the place of the

supplemental packing sheet, shortage list, modification list, Technical Order compliance list, Technical Order noncompliance list, and loose equipment list formerly required to be accomplished by the modification center. Distribution of parts 7 to 11, in blank, will be made to modification centers with requisition. Additional copies will be requisitioned as needed from the Commanding General, Air Service Command, Patterson Field, Fairfield, Ohio.

e. Use and Accomplishment by Tactical Organizations and the Air Service Command.-

(1) Because of the separate financial transactions between the Materiel Command, the aircraft prime contractor (parts 1 to 6, inclusive, form the basis for payment to the prime contractor), and between the Materiel Command and the contractor's modification center (parts 7 to 11, inclusive, are necessary in this case), work performed by the modification center must be listed separately, as must aircraft prime contractor's deviations from the original contract specification. For service use, a consolidation of such information is desirable in order to present the clearest possible picture of the items of equipment, changes, contract deviations, etc., incorporated in the aircraft.

(2) To avoid the necessity for checkers to consult several parts of Form No. 263A in checking aircraft for completeness of equipment, all pages of parts 2, 3, 7, 8, and 13 will be reviewed by service personnel immediately upon receipt of an aircraft from the modification center of Air Transport Command. Any items that are loose or easily removable, or that otherwise fall within the scope of the Form No. 263A as items whose physical presence should be checked at each transfer of the aircraft, will be entered on a blank line at the end of the proper section of part 1 (Equipment List).

(3) All remaining entries contained in parts 2, 7, and 13 covering completed work will be extracted to part 12 (Service Record of Permanent Additions and Modifications).

(4) Upon the accomplishment of the procedure outlined in paragraphs e(2) and e(3), the organization engineering officer or his authorized agent may authorize the withdrawal and destruction of parts 2 to 11, inclusive, and part 13, provided that no further recourse to those parts is considered necessary.

(5) After consolidation, entries in part 1 will represent items whose physical presence is to be checked for at each subsequent transfer of the aircraft. Part 12 will not be necessary in checking the aircraft at time of transfer, but will furnish a valuable resume of points of possible difference between the aircraft and other aircraft of the same model, giving the date and place where such features were incorporated.

(6) All further additions, removals, or modifications accomplished upon the aircraft by the Air Service Command or tactical organizations will be entered in the following manner:

(a) If a newly installed item is loose or easily removable, it will be entered at the end of the proper section of part 1. Such items will not be entered in part 12. Loose items will have their exact place of stowage noted in the "Remarks" column of part 1.

(b) If the item is such that later checks to insure its presence will not be necessary (such as camouflage paint for a bomb bay interior), entry will be made in part 12. If part 12 has previously had entries made therein, the entry will be made as a continuation of items previously entered by Air Service Command activities. Such items will not be entered in part 1.

(7) Items permanently removed from the aircraft will have their listing, if any, lined out. The authority for removal and name of the removing organization will be shown in the "Remarks" column.

(8) Items temporarily removed from the aircraft and not re-installed at time of transfer will not be lined out but will be entered in the standard shortage report, part 14.

(9) An item replaced by one having a new type or part number will have the obsoleted portion of the original entry lined out and the new data entered in place thereof. The reason for the change and the name of the organization making the change will be shown in the "Remarks" column.

(10) Part 14 (Standard Shortages Report) will be accomplished by the Air Service Command or tactical organization in the following manner:

(a) The aircraft model designation, AAF serial number, and names of the transferring and receiving organizations will be entered in the spaces provided in the heading.

(b) All shortages of required equipment existing at the time of departure from the transferring organization will be entered in part 14. Items temporarily removed from the aircraft for repair or for emergency use in another aircraft will be entered. Full particulars as to the reason for shortage, by whom the shortage is to be made up, and the approximate date and method of forwarding will be shown in the "Remarks" column.

(c) New items to be installed or work to be performed in accordance with directives from higher authority (except for Technical Orders or Service Bulletins issued in lieu thereof) but remaining unaccomplished at the time of transfer will be entered on the shortage list.

(d) The nomenclature listed will be the same, where applicable, as shown in part 1. The AAF or commercial model designation, if any, will be given at the end of the nomenclature.

(e) The part number or AAF stock number entered will be the same, where applicable, as that in the corresponding column of part 1.

(f) The quantity short, i.e., the number lacking to fill the aircraft's full complement of the item, will be noted in column 3.

(11) Part 15 (General Purpose Delivery Receipt) will be accomplished by the Air Service Command or tactical organization as indicated thereon.

(12) An initial supply of parts 12, 14, and 15 will be distributed to Air Service Command activities and tactical organizations without requisition. Additional copies will be requisitioned from the Commanding General, Air Service Command, Patterson Field, Fairfield, Ohio.

(13) When transfers of accountability or responsibility are made between AAF posts, camps, stations, and organizations in such a manner as not to necessitate passage through modification centers, organizational training unit schools, reconditioning units, or departure points, the shipping officer will execute part 14 in duplicate, one copy being retained by him and one copy accompanying the aircraft. One copy only of part 15 is necessary. Additional copies may be made if desired.

(14) When transfers involve passage through modification centers, organizational training unit schools, reconditioning units, concentration areas, or departure point, the correct number of copies of part 14, the responsibility for accomplishment, required distribution etc., will be as prescribed in AAF Regulation No. 65-47, "Responsibility for Fully Equipping Aircraft for Combat Operation."

f. Use and Accomplishment by the Air Transport Command.-

(1) Should aircraft be checked for completeness by Air Transport Command personnel, part 1 of Form No. 263A will be used as a guide in checking, bearing in mind that loose or easily removable items listed in parts 2, 3, 7, and 8 are also to be checked.

(2) Items temporarily installed or carried in the aircraft for use of Air Transport Command personnel, such as extra oxygen apparatus, extra float cans, extra emergency rations, etc., will be entered in part 13. Items listed in part 13 and later removed will have such entries lined out, and the name, rank, and organization of the person lining out the entries will be entered in the "Remarks" column. All items shown in Form No. 263A (except for items entered in part 13) are to remain with that aircraft permanently and will not be taken therefrom by any personnel whatsoever except by express permission of the tactical organization to whom the aircraft is to be delivered or by written authorization of the Commanding General, of either the AAF Materiel Center or the Air Service Command.

(3) Except for deliveries to or acceptance from the modification center, the Air Transport Command will use the general purpose delivery receipt contained in part 15.

(4) Should shortage reports be accomplished by Air Transport Command personnel, the instructions contained in paragraph e(8) will be followed. Copies of parts 13, 14, and 15, in blank, may be obtained by requisition from the Commanding General, Air Service Command, Patterson Field, Fairfield, Ohio.



Section *XXI*

WEIGHT AND BALANCE

1. General.

The data necessary to determine the exact weight and balance of the airplane is outlined in the Handbook of Weight and Balance Data, T. O. No. 01-1-40 or AN-01-1-40. It is important to remember that the records for each aircraft are different, and data listed in each Weight and Balance Handbook applies only to the individual airplane whose serial number appears on both the title page and the Weight and Balance Control Record Sheet.

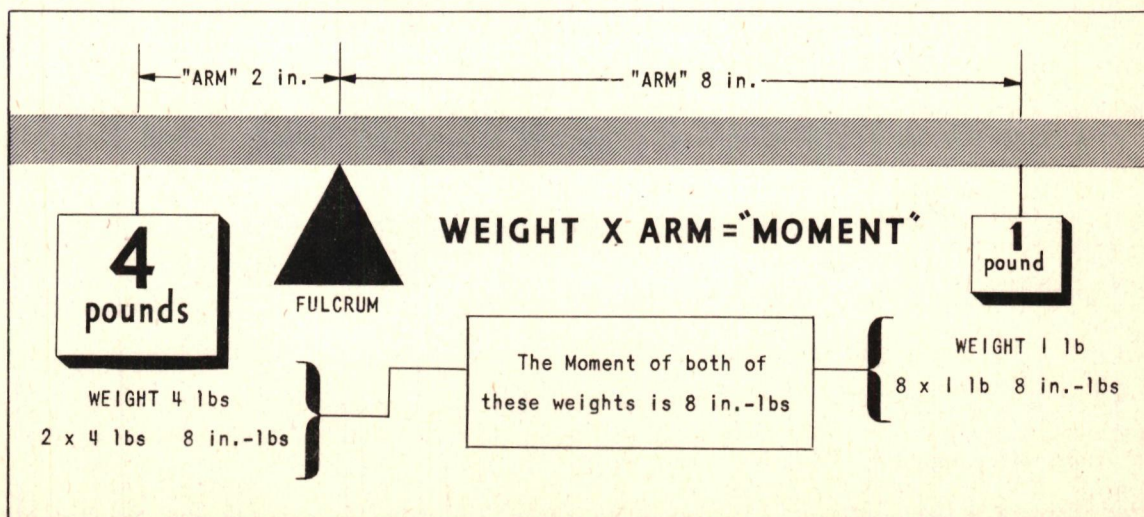
This book must remain in the data case of the airplane whose serial number appears on the title page. It is as much an integral part of the ship's records as its Form No. 1. This is required by AAF Regulation 55-3 and is to be adhered to by all activities.

In order to eliminate crashes caused by improper loading and improve the efficiency of the airplane, the Weight and Balance Handbook has been issued to provide a standardized and simple method for computing the correct loading of the airplane and also to create a permanent record of these data for the benefit of subsequent operators and pilots.

2. Principles of Balance.

The theory of aircraft weight and balance is extremely simple. It is that of the old familiar steelyard scale which is in equilibrium or balance when it rests on the fulcrum in a level position. It is apparent that the influence of weight is directly dependent on its distance from the fulcrum and that the weight must be distributed so that the turning effect is the same on one side of the fulcrum as on the other. A heavy weight near the fulcrum has the same effect as a lighter weight farther out on the bar. The distance of any object from the fulcrum is called its arm. This distance, or arm, multiplied by the weight of the object is its turning effect, or moment, exerted about the fulcrum.

Similarly, an airplane is balanced when it remains level if suspended at a certain definite point or ideal center of gravity (cg) location. Unlike a steelyard, it is not necessary that an airplane balances so that it is perfectly level, but it must be reasonably close to it. This allowable variation is called the cg range and the exact location, which is always near the forward part of the wing, is specified for each airplane model. Obtaining this balance is simply a matter of placing loads so that the average arm of the loaded airplane falls within this allowable cg range. Heavy loads near the wing location can be balanced by much lighter loads at the nose or tail of the airplane. The moments determine this exactly.



It has been found desirable to measure all distances from an arbitrary reference datum line near the nose of the airplane. By measuring arms in the same direction, all moments become positive, thus eliminating possible errors in adding plus and minus moments that result from a reference datum line located farther aft.

When the total moment about this reference datum line is divided by the total weight, the resulting arm is the distance to the center of balance, or center of gravity, from the reference datum line. This would be the location of the fulcrum on the balanced steelyard scale. If the cg falls within the cg limits, expressed as minimum and maximum limiting moments over 1000 on chart E, the loading is satisfactory. If not, the load must be shifted until the cg does fall within the limits.

For flight, since the wing supports the airplane's weight, it is obvious that the cg must remain within safe allowable limits; otherwise, the tail surfaces could not properly control the path of flight. These limits are determined by actual test flight. Limits are usually expressed as a percentage of the mean aerodynamic chord of the wing (percent MAC), an engineering term. For weight and balance purposes, the cg limits are determined by the Limiting Moments/1000 vs. Gross Weight Chart on chart E.

3. Charts and Forms.

There are only two parts to the weight and balance problem. In the first place, one must have correct information as the ever essential beginning point - the basic weight and moment. Secondly, balance must be maintained within safe limits with the addition of useful load. The first part is controlled by three charts, A, B, and C, which are contained within the Handbook proper. The second part is actually performed by means of loading charts and graphs for the airplane and is then tabulated on clearance Form F, occasionally including a supplement form F-1.

Chart A - Basic Weight Check List is a list of all items of fixed equipment that may at some time be installed in the aircraft in a definite location. It gives the weight and moment of the individual item for use in making changes in the basic airplane. The check marks entered in the columns, indicate that the items are installed in the airplane and are considered part of the basic weight and moment/1000.

Chart B - Record of Structural Changes is provided to preserve a record of the modifications and changes in weight not indicated by definite items on chart A.

Chart C - The Log (Basic Weight and Moment Record) provides a standard work sheet upon which to enter the changes in the basic weight and thus maintain a record of the current status of the basic airplane.

Charts A, B, and C should be checked and brought up-to-date as follows:

- a. When the airplane is received at a new base.
- b. When modifications or structural changes are made
- c. When the airplane has a major overhaul or engine change.
- d. When changes in equipment are made for a different type of operation or mission.
- e. When a pilot reports tail or nose heaviness in flight.
- f. When it is suspected that the forms are not up-to-date.
- g. When the airplane is re-weighed.

To use the loading charts satisfactorily, the total amount of variable load in each compartment must be known and tabulated. This may be done in detail on Form F-1 and the compartment totals then entered on Form F.

Form F is the summary of the actual disposition of load in the aircraft and records the

balance status step by step. It is necessary to accomplish Form F prior to flight whenever an airplane is loaded in a manner for which no previous tabulation is available.

Form F-1 is a standard means for the ground crew to list in detail the items actually loaded in each compartment so that the pilot or weight and balance officer will have figures for checking the compartment totals. It may be used also as a form on which to list equipment requirements to aid loading crews in laying plans for the movement of groups of similar aircraft.

Sample charts are provided with the instructions for using the charts as an aid in demonstrating the function of these charts.

4. Actual Weighing of Airplane.

The airplane must be weighed in a closed hangar in the following manner:

Thoroughly clean the airplane inside and out. Check the airplane equipment against chart A and correct the chart as necessary to accurately itemize all items of fixed equipment that will be included in the basic weight to be determined by the weighing. See that the date at the top of the CHECK column corresponds with the date entered on the weighing form and final entry posted in the log, chart C.

Bombs, ammunition, cargo, crew members, and loose equipment not having a fixed location are not to be listed as a part of chart A, and are not to be in the airplane when weighed. Hydraulic, anti-icer fluids, etc., are items of fixed equipment that remain in the airplane as part of the basic weight, and their reservoirs or containers should be filled to capacity prior to weighing. Engine oil and fuel (except trapped) are not items of basic weight. All fuel and oil tanks should be drained using only tank drains with the airplane in its normal ground attitude. However, if it is impractical to drain oil, the oil tank should be filled to a known quantity and the weight and moment later deducted on the lower section of the weighing form.

After the airplane is prepared for weighing as stated above, place calibrated scales of a suitable capacity under each wheel. Care must be exercised when placing the airplane upon the platforms of scales because an abrupt application of the airplane's weight may seriously disturb the calibration of the scales and cause inaccuracy. Brakes shall be released at all times while the airplane is on the scales.

Level the airplane longitudinally and laterally, using the regular airplane leveling lugs and spirit level. When weighing the airplane, the tail wheel must be locked in the "TRAILING" position and the tail wheel shock strut under standard static deflection. Under these conditions the arm E will be 123.5 inches and F, 379.0 inches.

Enter the scale readings on the weighing form provided. Take measurements and complete the new basic weight and moment by completing the weighing forms.

Enter the new basic weight and moment in the log, chart C. All subsequent airplane loadings will be based on these figures.

AIRPLANE WEIGHING FORM

Wheel	Scale Reading	Tare	Net Weight	Arm	Moment
Left Main	4510	10	4500		
Right Main	4550	100	4450		
Sub-Total (Both Main)	9050	110	8950	123.5(E)	1,105,325
Tail	624	164	460	379.0(F)	174,340
Total (As Weighed)	9674	274	9410	136.0(H)	1,279,665

INSTRUCTIONS:

1. Enter scale reading in first column.
2. Subtract tare, if any, from scale reading to obtain new weight.

3. Arm E = 123.5; F = 379.0

4. Multiply the sub-total net weight of main wheels, and the net weight of tail wheel, by their respective arms (dimensions E and F) to obtain their moments.

5. Add net weights and moments of the main wheels and nose or tail wheel.

6. Divide the total moment by the total net weight to obtain the cg position in inches from the reference datum line (h).

Description	Net Weight	Arm	Moment
* Total (As Weighed)	9410	136	1,279,665
** Oil in Airplane	0		
** Total of Items Weighed but Not Part of Basic Weight	0		
*** Total of Basic Items Not in Airplane When Weighed.	0		
Basic Airplane (Post to Chart C)	9410	136	1,279,665

* Post from upper chart to lower chart.

** Subtract weight and moment in accordance with actual weighing instructions in the text.

*** Be absolutely sure these items are subsequently installed and checked off in chart A as actually being in the airplane.

5. Instructions for Using Chart A.

This chart is a check-off list for all fixed equipment (machine guns, camera, etc.), which (1) has a definite location in the airplane, (2) is, or at some time may be, in the airplane and (3) is an alternate installation for standard equipment.

At the time of delivery of a new airplane, the manufacturer enters the above items on this form, in groups, according to compartment location. The item number is prefixed with the compartment letter designation from chart E. This list should be as complete as possible, and must be kept up-to-date.

The weight, arm, and moment for each item is listed for all items of equipment, including possible alternate load items. A constant, 1000, is used to simplify the moment, it should be inserted at the top of the moment column.

A check (✓) in the column headed "In Airplane," indicates the presence of the item in the airplane on the date at the head of the column. Items should not be checked unless they are installed and items not checked are not included in the basic weight and balance tabulated on chart C for the corresponding date. Check marks should never be changed or added in a previously checked column. When a complete inventory is taken on a later date, the next check column is used.

When a listed item not previously in the airplane is installed, the weight and moment shown on chart A should be added to the last basic weight and moment/1000 on chart C. If an unlisted item is installed in the airplane, write in its name or description, under the proper compartment together with the authorizing change order number if applicable and list its weight, arm, and moment on chart A. Add its weight and moment to the last weight and moment on chart C. The arm may be determined with the aid of the airplane diagram on chart E.

When an item is removed from the airplane, subtract its weight and moment on chart C.

During a complete inventory, any change made in equipment since the previous inventory becomes obvious when the check marks of the first inventory are compared with the second. Refer to chart C and ascertain whether correct changes in the basic weight and moment have been made in the interval between inventories. If each change indicated by the difference of check marks has been made, place a check mark (✓) in the "Log Entry" column. If it has not been made, add entry and then place a check mark (✓) in the "Log Entry" column.

4-1-43

CHART
A
SHEET 1

MFR. SERIAL NO.

Y 13 H 3

• RECORD OF CHECKING •

RESTRICTED

4-1-43

A

AIRPLANE MODEL A-25A AF SERIAL NO. _____ MFR. SERIAL NO. _____

MFR. SERIAL NO.

AF SERIAL NO.

A-25A

[illegible]

CHART
A
SHEET 3

• RECORD OF CHECKING •

[illegible]

RESTRICTED

Section XXI

[illegible]

4-1-43

CHART
A
SHEET 5

MFR. SERIAL NO.

• RECORD OF CHECKING •

6. Instructions for Using Chart B.

This chart serves as an historical record of structural changes and the replacement of major items such as engines, propellers, cowling, tires, ordnance installations, self-sealing fuel cells, etc. not covered by chart A.

The manufacturer made no entries on this form unless modifications or changes were made after actually weighing and determining the basic weight and moment. Entries are to be made by a weight and balance officer, or by an engineering officer at an overhaul or modification center, as follows:

Column 1 - Enter date of change.

Column 2 - Enter sufficient description of changes to identify it, including the authorizing order number of all changes.

Column 3 - Enter net weight increase or decrease (+ or -).

Column 4 - Enter arm (distance from reference datum line to cg of the change).

Column 5 - Enter the moment/1000 increase or decrease (+ or -).

Transfer total weight and moment/1000 of each group of entries to chart C and make any necessary change on chart A.

The net change in weight and moment/1000 is to be registered on chart C. This form may also be used to list minor changes which are not great enough to justify changing the basic weight and moment. When the total number of small changes becomes appreciable, it may be entered in chart C. This reduces the number of basic log entries without losing the accumulative effect of numerous small changes.

7. Instructions for Using Chart C.

Chart C is a permanent running record of the changes in an airplane's basic weight, moment, and index. At all times the last weight, moment, and index entry is considered the current weight and balance status of the basic airplane.

At time of delivery of a new airplane, the manufacturer enters on this chart the basic weight, moment, and index of the airplane. The itemized list of the equipment included is shown and checked on chart A in the delivery column.

The log entry date must be consistent with the dates entered at the top of the check column on chart A and on the airplane weighing forms.

Whenever equipment is added to or removed from the airplane, the item number, nomenclature, weight, and moment should be obtained from chart A and entered in the appropriate columns on chart C. The necessary corrections should then be made to the progressive totals. In order to preserve a record of added basic equipment, unlisted equipment which is added to the airplane should be tabulated on chart A, using the actual weight and measured moment-arm of the items.

Structural modifications or changes are to be recorded first on chart B and the net change in weight and moment added to or subtracted from the last previous total on chart C.

The effect of changes in equipment which have been transferred from chart A and the effect of structural modifications which have been transferred from chart B keep the log correct and up-to-date.

Any change or modification which is caused by a specific order should carry a reference to the order number which authorizes the change.

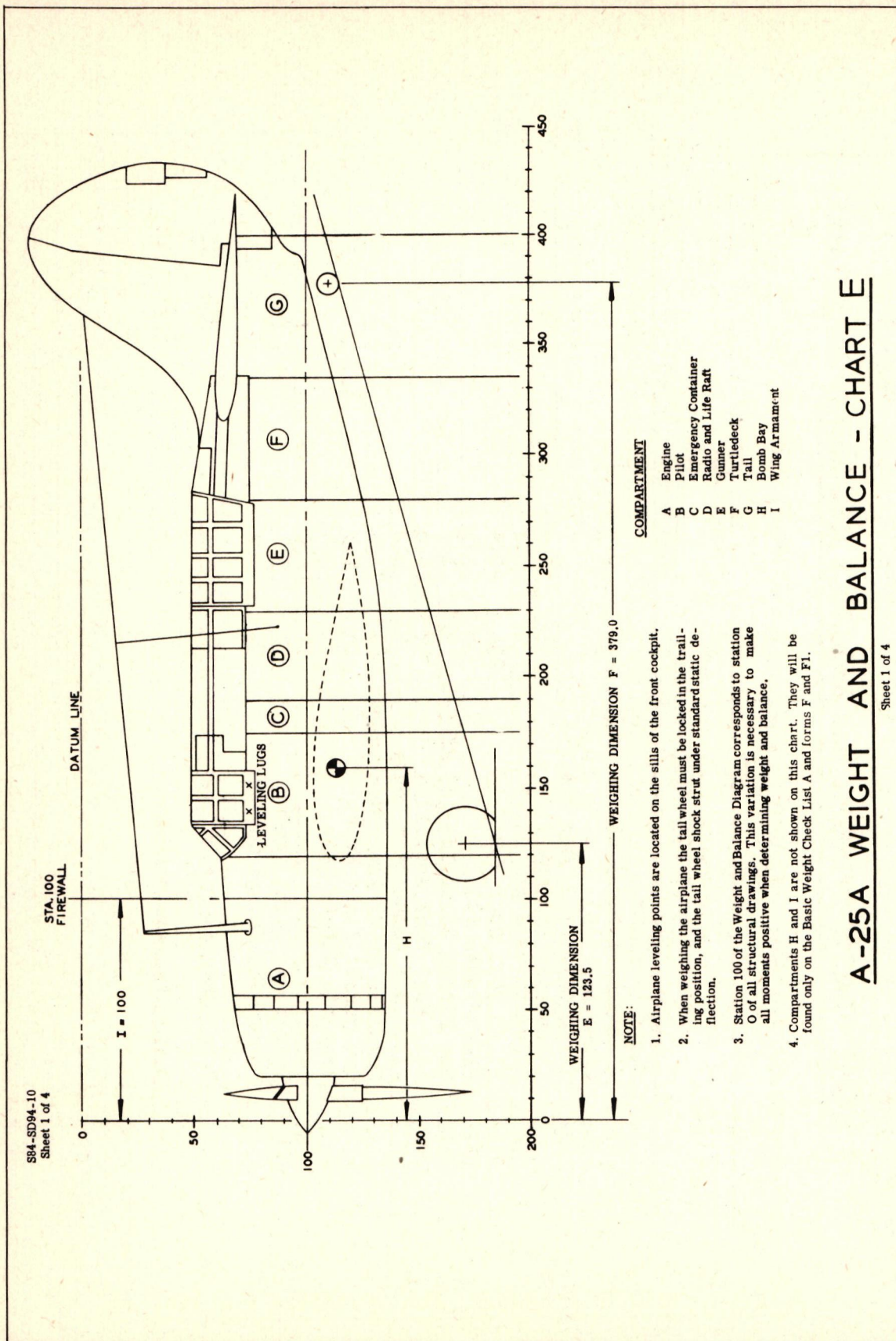
8. Chart E.

Chart E lists the weight, arm, and moment of all expendable load items such as fuel, oil, ammunition, bombs, etc. The airplane has been divided into compartments to facilitate checking chart A, and completing Forms F and F-1. The maximum capacity of compartments C, the emergency container rack and D, the life raft container is 50 pounds each. The maximum capacity of compartment F, the turtledeck, is 100 pounds.

S84-SD94-12

LOG • BASIC WEIGHT and BALANCE RECORD •**CHART****C****SHEET 1**AIRPLANE MODEL **A-25A** AF SERIAL NO. _____ MFR. SERIAL NO. _____

DATE	ITEM NO.	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE				RUNNING TOTAL BASIC AIRPLANE		
			ADDED (+)		REMOVED (-)		WEIGHT	MOMENT 1000	
			WEIGHT	MOMENT 1000	WEIGHT	MOMENT 1000			
		Basic Airplane					9410	1279.7	
	8B	Illuminated Sight MK.-8	4	0.4					
	1D	Radar SCR-535	37	7.0					
	6E	1-.50 Cal. Flex. Gun (less install. and amm.)	64	17.2					
	9E	Illuminated Sight MK.-9	2	0.4					
	1I	4-.50 Cal. Guns M-2	256	42.4					
	3I	BlaaT Tubes (4)	8	1.1					
	4I	Gun Firing Solenoids (4) MK-5-1	9	1.6					
	6H	Aux. Fuel Tank Installed	92	15.6					
	-	Flex. Gun Ammunition Chute	5	1.2					
		Complete W. E. Flex. Gun Turret	266	72.4					
		Gun Turret Sight Mount	16	4.3					
		Gunner's Safety Belt	3	0.8					
	3E	Turret Gun Skirt Armor	54	14.9					
	2E	Turret Gun Sight Armor	19	5.1					
		Turret Gun Manual Charger	3	.9					
		Total Changes for Delivery	838	185.3			838	185.3	
		Basic Airplane-Delivery					10248	1465.0	



LIMITING MOMENTS/1000 VS GROSS WEIGHT				
GROSS WEIGHT	MINIMUM	BEST	MAXIMUM (See Note 1)	
			COMBAT	FERRYING
11000	1537	1597	1645	1681
11250	1571	1633	1682	1719
11500	1607	1669	1720	1757
11750	1641	1706	1757	1796
12000	1676	1742	1794	1834
12250	1711	1778	1832	1872
12500	1746	1815	1869	1910
12750	1781	1851	1907	1948
13000	1816	1887	1944	1987
13250	1851	1924	1981	2024
13500	1886	1960	2019	2063
13750	1921	1996	2056	2101
14000	1956	2032	2094	2139
14250	1991	2069	2131	2178
14500	2026	2105	2168	2216
14750	2061	2141	2206	2254
15000	2096	2178	2243	2292
15250	2130	2214	2280	2331
15500	2165	2250	2318	2369
15750	2200	2286	2355	2407
16000	2235	2323	2392	2445
16250	2270	2359	2430	2483
16500	2305	2395	2467	2522
16750	2340	2432	2505	2560
17000	2375	2468	2542	2598

Item	Weight	Moment/1000
Bomb Bay (bomb bay arm = 170) (Compartment H)		
1 - 500# bomb	500	85.0
1 - 1000# bomb	1000	170.0
1 - 1600# bomb	1600	272.0
Wing Armament (arm - 157) (Compartment I)		
1 - 100# bomb	116	18.2
1 - Smoke tank MK 7-1	328	51.2
1 - Depth bomb MK 17-1	325	51.0
1 - Miniature practice Bomb MK 5-1	2.7	.4
Crew		
Pilot and chute (Compt. B)	200	29.2
Gunner and chute (Compt. E)	200	51.2

CARGO LOADING BY COMPARTMENTS				
WEIGHT	MOMENT/1000			
	C	D	E	F
10	1.8	2.1	2.6	3.0
20	3.6	4.1	5.1	6.0
30	5.3	6.2	7.7	9.0
40	7.1	8.2	10.2	12.0
50	8.9	10.3	12.8	15.0
60			15.4	18.0
70			17.9	21.0
80			20.5	24.0
90			23.0	27.0
100			25.6	30.0
110			28.2	
120			30.7	
130			33.3	
140			35.8	
150			38.4	
160			41.0	
170			43.5	
180			46.1	
190			48.6	
200			51.2	

Maximum baggage in compartments C and D, 50 lb each; F, 100 lb. Total baggage and/or turret ammunition should not exceed 200 lb in compartment E.

WING GUN AMMUNITION .50 CALIBRE (Compt. I)		
Rounds	Weight	Moment/1000
200	60	9.8
400	120	19.7
600	180	29.5
800	240	39.3
1000	300	49.1
1200	360	59.0
1400	420	68.8
1600	480	78.6

NOTES:

- The airplane is neutrally stable at the maximum limiting moment/1000 for combat. The airplane is controllable but unstable to the maximum limiting moment/1000 for ferrying.
- Weight of .50 calibre ammunition 30#/100 rounds. Turret ammunition is in compartment E.
- The final weight and moment/1000 column in form F is for wheels down. Add 6.2 to the moment/1000 column to determine the wheels up moment.

A-25A WEIGHT AND BALANCE - CHART E

Sheet 2 of 4

NOTE: Fuel should be used during flight in the following order:

Auxiliary Tank (if installed)
Fuselage Tank
Left Wing
Right Wing

Tanks should be filled in reverse order.

FUEL CHART			
	FUEL GALLONS	WEIGHT	MOMENT/1000
RIGHT WING 105 GALLONS	10	60	10.6
	20	120	21.1
	30	180	31.7
	40	240	42.2
	50	300	52.8
	60	360	63.4
	70	420	73.9
	80	480	84.5
	90	540	95.0
	100	600	105.6
PLUS LEFT WING 105 GALLONS	110	660	116.2
	120	720	126.7
	130	780	137.3
	140	840	147.8
	150	900	158.4
	160	960	169.0
	170	1020	179.5
	180	1080	190.1
	190	1140	200.6
	200	1200	211.2
PLUS FUSELAGE 120 GALLONS (Self Sealing)	210	1260	221.8
	220	1320	232.5
	230	1380	243.2
	240	1440	254.0
	250	1500	264.7
	260	1560	275.5
	270	1620	286.2
	280	1680	296.9
	290	1740	307.7
	300	1800	318.4
PLUS AUXILIARY 130 GALLONS	310	1860	329.2
	320	1920	339.9
	330	1980	350.6
	340	2040	360.8
	350	2100	371.0
	360	2160	381.2
	370	2220	391.3
	380	2280	401.5
	390	2340	411.7
	400	2400	421.8
	410	2460	432.0
	420	2520	442.2
	430	2580	452.3
	440	2640	462.5
	450	2700	472.7
	460	2760	482.9

OIL CHART		
GALLONS	WEIGHT	MOMENT/1000
6	45	4.2
8	60	5.6
10 (Minimum)	75	7.1
12	90	8.5
14	105	9.9
16	120	11.3
18	135	12.7
20	150	14.1
22	165	15.5
24	180	16.9
25 (Maximum)	188	17.7

	GALLONS	WEIGHT	MOMENT/1000
PLUS FUSELAGE 90 GALLONS METAL	220	1320	232.5
	230	1380	243.2
	240	1440	254.0
	250	1500	264.7
	260	1560	275.5
	270	1620	286.2
	280	1680	296.9
	290	1740	307.7
	300	1800	318.4
	310	1860	328.6
PLUS AUXILIARY 130 GALLONS	320	1920	338.8
	330	1980	348.9
	340	2040	359.1
	350	2100	369.3
	360	2160	379.4
	370	2220	389.6
	380	2280	399.8
	390	2340	410.0
	400	2400	420.1
	410	2460	430.3
	420	2520	440.5
	430	2580	450.6

A-25A WEIGHT AND BALANCE - CHART E

Sheet 3 of 4

SAMPLE LOADING CONDITIONS

The following charts list the items of useful load which appear on form F.

For the specific conditions outlined below, the gross weight and moment/1000 may be determined by adding the basic weight and moment/1000 from chart C, to the useful load weight and moment/1000.

These conditions are only given to serve as an aid in completing form F

COMBAT		
Items of Useful Load	Weight	Moment/1000
Pilot	200	29.2
Gunner	200	51.2
Turret Ammunition (470 rds .50 cal)	141	36.1
Wing Gun Ammunition (1600 rds .50 cal)	480	78.6
Oil (25 gal.)	188	17.7
Fuel		
(210 gal. Wing)		
plus (120 gal. Fuselage)		
plus (130 gal. Auxiliary)	2760	482.9
Total	3969	695.7

FERRYING		
Items of Useful Load	Weight	Moment/1000
Pilot	200	29.2
Crew Chief	200	51.2
Baggage on Turtle Deck (F)	40	12.0
Baggage in Turret (E)	40	10.2
Baggage in Life Raft (D)	35	7.2
Baggage on Emergency Container Rack (C)	35	6.2
Oil (25 gal.)	188	17.7
Fuel		
(210 gal. Wing)		
plus (120 gal. Fuselage)		
plus (130 gal. Auxiliary)	2760	482.9
Total	3498	616.6

BOMBER		
Items of Useful Load	Weight	Moment/1000
Pilot	200	29.2
Gunner	200	51.2
1 - 1000# Bomb or 2 - 500# Bombs	1000	179.0
2 - 100# Wing Bombs	232	36.4
Turret Ammunition (470 rds .50 cal)	141	36.1
Wing Gun Ammunition (1600 rds .50 cal)	480	78.6
Oil (20 gal.)	150	14.1
Fuel		
(210 gal. Wing)		
plus (120 gal. Fuselage)	1980	350.6
Total	4383	866.2

A-25A WEIGHT AND BALANCE - CHART E

Sheet 4 of 4

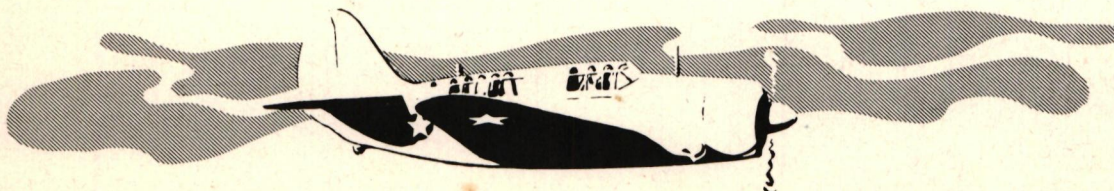
The maximum limiting moment/1000, i.e. the most rearward cg, has been divided into two groups, the maximum limit for combat and maximum limit for ferrying. The airplane is stable at the maximum limiting moment/1000 for combat and is controllable but unstable to the maximum limiting moment/1000 for ferrying.

Maneuvers should not be performed with the airplane when the limiting moment/1000 exceeds the limiting moment/1000 for combat.

The fuel chart on chart E has been divided into two sections. The left side should be used when a 120-gallon self-sealing fuselage tank is installed. The right side is used when the 90-gallon metal fuselage tank is installed. The tanks should be filled in the following order; right wing, left wing, fuselage, and auxiliary tank. Fuel should be used during flight, except take-off, in the reverse order. Sample loading conditions are included on the last page of chart E to aid in the completion of Form F.

9. Instructions for Using Form F.

- a. Insert the necessary identifying information at the top of the form.
- b. Enter basic airplane weight and index at top of the left-hand column. Obtain these figures from the last entry on chart C.
- c. Using the same compartment letter identification as shown on chart E, enter the crew and cargo weights for each compartment in the "ITEM" column. Post each compartment total to the weight column.
- d. List the ammunition by compartment, giving the caliber and number of rounds, and insert weight and moment/1000.
- e. List the number and size of bombs, etc., and enter the total weights and moment/1000 in the specified columns.
- f. List by tanks, the amount, weight, and moment/1000 of all fuel loaded. Group fuel tank nomenclature. Post the respective weights and moment/1000.
- g. List the amount, weight, and moment/1000 of the oil, and post weight and moment/1000 in the appropriate column.
- h. Add the weight and moment/1000 column and determine the gross weight and corresponding moment/1000.
- i. Determine from the limiting moment/1000 vs. gross weight chart on chart E whether the loading is within the permissible limits. If it is not, the airplane must be ballasted or some of the load shifted to bring the limiting moment/1000 vs. gross weight within the desired limit. Moving a load aft will increase the moment/1000; moving a load forward will decrease the moment/1000.
- j. Enter "Take-off Weight and Moment/1000."
- k. Secure necessary approval and signatures at the bottom of Form F.



4-1-43

WEIGHT and BALANCE CLEARANCE**FORM
F**

DATE _____ MISSION _____
 AIRPLANE A-25A FROM _____
 AF SERIAL NO. _____ TO _____

Note: Index = Moment/1000

COMPARTMENT	ITEM	WEIGHT	INDEX	COMPARTMENT	ITEM	WEIGHT	INDEX
Y	Basic Airplane	10248	1465.0	Y	Totals Brought Forward	10648	1545.4
(A) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL			(Q) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL		
(B) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL	200	29.2	(R) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL		
(C) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL			(S) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL		
(D) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL			(T) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL		
(E) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL	200	51.2	AMMUNITION (By Compartment)	() Rds. (50) Cal.		
(F) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL				Compartment E		
(G) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL				100 Rds. 50 Cal.	120	30.7
(H) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL				Compartment I		
(I) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL				1600 Rds. 50 Cal.	480	78.6
(J) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL						
(K) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL						
(L) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL						
(M) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL				Forward One - 1000 lb	1000	170.0
(N) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL				Aft		
(O) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL			BOMBS	External Two - 100 lb	232	36.4
(P) _____ lb. (STRUCTURAL CAPACITY)	Crew Cargo TOTAL						
TOTALS TO BE CARRIED FORWARD		10648	1545.4	FUEL (U. S. 6 & Imp. 7.2 lb./gal.)			
				Right Wing 105			
				(Plus) Left Wing 105			
				(Plus) Fuselage (Metal) 90			
				Total 300 1800 318.4			
				Bomb Bay:			
				OIL (U. S. 7.5 & Imp. 9 lb./gal.)			
				25 Gallons 188 17.7			
				TOTAL WT. & INDEX (Uncorrected) 14468 2197.2			
				Corrections (If required)			
				TAKE - OFF WEIGHT & INDEX			
				LIMITS			
				Max. Alternate Gross Weight 2197.2 LB.			
				Max. Allowable Landing Weight			
				COMPUTED BY _____			
				APPROVED BY _____			
				PILOT _____			

Section XXII

PARACHUTES



1. General.

The instructions in this section pertain to the conventional circular type parachute and are compiled from Technical Manual No. 1-440. The complete parachute assembly consists of three major units; the canopy, the pack assembly, and the harness. These units are manufactured in various types and sizes depending upon the purpose for which they are to be used. The following list shows the various types of parachute assemblies, together with other pertinent data:

<u>Types</u>	<u>Description</u>	<u>Dia. in Feet</u>	<u>Weight of Wearer</u>
S -----	Seat, service, small -----	24-----	Under 180 pounds.
S -----	Seat, service, large -----	28-----	Over 180 pounds.
T-----	Training (double) -----	22 and 28 ----	No limitation.
B-----	Back, service -----	24-----	No limitation.

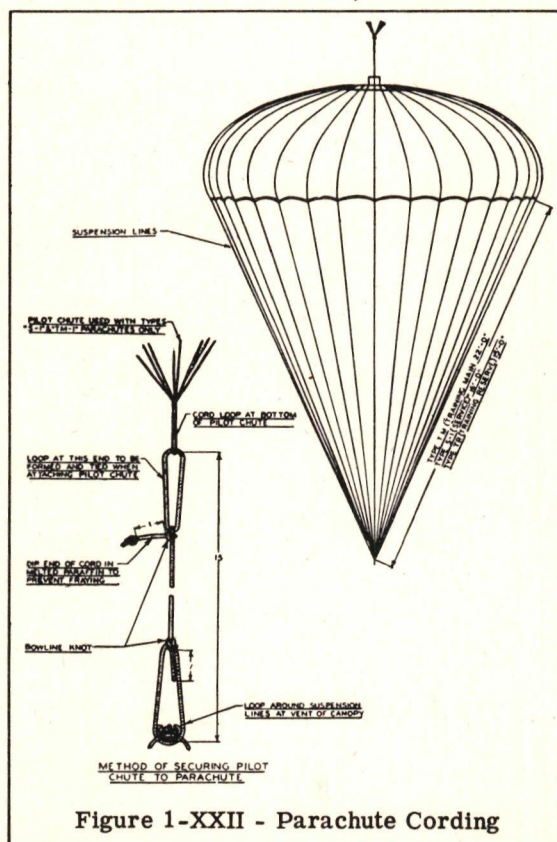


Figure 1-XXII - Parachute Cording

2. Canopy.

a. Construction.-

(1) The canopy, which is constructed of high-grade silk fabric, constitutes the lifting surface of the parachute assembly, and as shown in fig. 1-XXII has a framework of cords, known as suspension lines, by which the load on the parachute is suspended. These lines vary in number depending upon the size of the canopy. Each line extends from a connector link on one side of the harness riser to the skirt of the canopy, thence through a channel in the silk covering, entirely across the surface of the canopy to a point on the skirt diametrically opposite, and continuing to the riser on the other side of the harness. This permits each line to be a continuous length from one side of the harness to the other. The lines cross each other at the apex of the canopy as shown in fig. 2-XXII.

(2) That part of the canopy between any two suspension lines is known as a panel.

(3) The panels are further subdivided into sections. The silk of each section is cut on a bias, as shown in fig. 2-XXII with the warp of the fabric running at a 45 degree angle to the center line of the panel. This arrangement not only permits greater economy in cutting the fabric, but

also prevents any runs or tears from extending beyond the seams that are formed by joining the sections together.

(4) Completely encircling the panels at both the skirt and apex of the canopy are bands of 300-pound capacity, reinforcing silk tape. These are known as lateral bands, and serve to reinforce and strengthen the body of the canopy. The apex is reinforced with two thicknesses of this tape in the hem to compensate for the heavy strain imposed on it when the parachute is opened.

(5) A device at the apex opening, known as the puckered vent, functions to relieve the initial opening strains on the canopy. This operates by means of an elastic, which permits the vent to open wide under the excessive opening pressure caused by high speed, then close again as the parachute reaches its normal rate of descent.

(6) To facilitate the opening of the canopy, a small parachute (36 inches in diameter), known as the pilot parachute, is attached to the apex of the canopy. The pilot parachute is constructed in much the same manner as the main canopy, except for the inclusion of a spring-operated quick-opening device. When the rip cord is pulled, the pilot parachute is projected into the airstream and immediately filled with air, drawing the main canopy out of the pack and into position for opening. While the canopy will open without the assistance of the pilot parachute, the opening is slower and not as positive.

b. Types of Canopies.- Canopies are manufactured in the following sizes:

Type	Description	Dia. in Feet	Rate of Descent (feet per second)	Used with Packs, Types
S -----	Parachute, service, small---	24	16 to 24 -----	S or B.
TM -----	Parachute, training, main or parachute, service, large-	28	14 to 20 -----	S or BT.
TR -----	Parachute, training, reserve	22	17 to 26 -----	CT.

3. Pack.

a. Construction.- The pack is that part of the parachute assembly in which the canopy and its folded suspension lines are packed and carried. Packs are fabricated of 12-ounce duck in various sizes, depending upon the purpose for which they are to be used, and are classified as follows: "S" (seat), "B" (back), "CT" (chest training), and "BT" (back training). The classification also includes the size of the canopy that it will contain. The bottom of the pack is semirigid in construction, being reinforced by a frame of solid drawn wire. The folded suspension lines are held in place by rubber loops attached to an inner bottom made of duck and supported by two strips of webbing. The sides and ends of the pack are so constructed as to completely inclose the assembly, yet allow instant release of the pilot parachute and canopy when the rip cord is pulled. The rip cord consists of a 3/32-inch, stranded, flexible steel cable, which varies in length, depending upon the type of pack employed. On one end is attached a grip or handle by means of which the rip cord is pulled. The opposite end has two or three solid drawn-wire prongs which serve as the locking device for the pack assembly, and which must be withdrawn to release the canopy. The cable is inclosed in a flexible housing, one end of which is attached to the harness, so that the grip is readily accessible to the wearer.

This housing provides protection for the rip cord and prevents any possibility of premature releasing of the parachute. The cable length for rip cords is measured from the grip to the end of the last wrap that holds the locking pins to the cable. The back-type rip cord is 34 inches in length, while the seat type is 29-1/4 inches, and the chest type, 3-1/4 inches. The cable should be checked for length just before installing. The rip cord locking pins on the cable are 2-1/4 inches long. One inch of the pin is wrapped with fine wire and soldered to the cable, while the remaining 1-1/4 inches is exposed. The seat and chest packs have two pins, and the back-type has three. To insure positive opening of the pack after the rip cord has been pulled, elastic cords, known as pack-opening elastics, are used. These cords

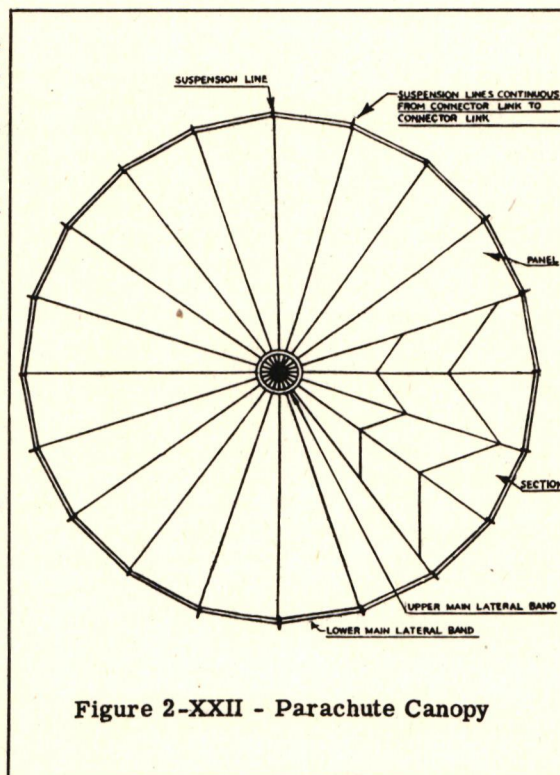


Figure 2-XXII - Parachute Canopy

are installed under tension in such a manner that when the rip cord is pulled, the sides and ends of the pack are forced away from the folded parachute. This permits the pilot parachute to be projected into the air, drawing the canopy from the pack and into position for opening. Directly under the side flaps of the pack are two similar pieces known as pilot-parachute flaps. When the canopy is folded and the sides and ends of the pack are in place, these superimposed flaps form a separate compartment in which the pilot parachute is placed. This arrangement assures the quick release of the pilot parachute and also serves to separate it from the canopy, lessening the danger of entanglement.

b. Types of Pack Assemblies. - The following table gives the types of packs used:

<u>Type</u>	<u>Description</u>	<u>Parachute Assembly</u>	<u>Canopy Feet</u>
S -----	Service, small -----	S --seat, service (small) ---	24
S -----	Service, large -----	S --seat, service (large) ---	28
B -----	Service, back -----	B --back, service -----	24
BT -----	Training, back -----	T --training (double) -----	28
CT -----	Training, chest -----	T --training (double) -----	22

4. Harness.

a. Construction. - The harness consists of a fabrication of webbing that secures the parachute to the wearer. The service or (S) type of harness is in general use and will therefore be referred to in the following description. The principal elements are two main lift webs, which are composed of four pieces of three-ply linen webbing, sewed together. This provides two continuous lengths of double webbing to form the loops for the adjustable leg straps and the cradle or swing. When descending by the aid of a parachute, the wearer sits in the loop of this swing with the suspension lines of the canopy attached to the upper ends. The remaining webbing, comprising the harness, is for the purpose of preventing the wearer from slipping out by providing a means of adjusting and securing the assembly to the individual. Two additional webs extend from a point near the chest (under the breast guard protector) on the right and left main lift webs to the shoulder adapter to support the back straps. These webs cross the back of the wearer through the main lift web at a point near the tip, and continue horizontally to the rear at the small of the back where they are interlocked and fitted so as to be adjustable for size. A breast strap is attached at a point near the center of the chest to keep the entire harness assembly in position and to prevent the main lift webs from slipping from the shoulders. The metal fittings attached to the harness include four double and one triple adapter as well as three male and three female fasteners. Noncorrosive cadmium plated chromium-nickel is used for the fittings. Two adapters are provided for adjusting the harness at the leg straps, while two more are placed at the shoulders for holding the harness. The triple adapter is used for adjusting both the cross strap and the horizontal straps around the small of the back. Male and female fasteners are used on the leg straps, hip straps, and breast guards of the harness. The following table lists the types of harness in general use.

<u>Harness Types</u>	<u>Description</u>
S -----	Used with both seat parachutes.
D -----	Used with double training parachutes.
B -----	Used with back parachutes.

b. Definitions. - The different parts of the harness may be defined as follows:

(1) Main Lift Webs. - These webs form the cradle and leg straps by means of two continuous lengths of double webbing, sewed together to form loops and extending to the risers at the shoulder adapters.

(2) Risers. - A continuation of the main lift webs, from the shoulder adapters, for attachment to the connector link.

(3) Seat. - This is often called the cradle, swing, or loop.

(4) Leg Straps. - Two adjustable loops fitted with a male and female fastener at the seat and formed from the main lift webs.

(5) Back Diagonal Cross Straps.- Two additional webs, which are sewed on the inside of the main lift webs at a point near the chest. These webs extend to the shoulder adapter and cross the back, diagonally, through openings provided on the sides of the harness at the hips. Attachment is made to the leg straps by male and female fasteners.

(6) Back Horizontal Cross Straps.- A continuation of the diagonal cross straps. These webs pass through the opening provided in the main lift web at the hip, and extend around the small of the back where they are fastened with the triple adjusting adapter.

(7) Hip Straps.- The loops which extend approximately three inches through the openings provided in the main lift webs, at the hip, for the horizontal and diagonal back straps. The hip straps terminate in male and female fittings for the purpose of fastening to the leg straps.

(8) Breast Straps.- Additional members of the harness assembly, fitted with a male and female fastener, and fastened to the main lift webs at the breast. These straps are adjustable for up and down movement and are covered with duck protectors.

(9) Harness Fittings.- Eleven metal fittings on the harness, consisting of matched male and female fasteners, double adapters, and a triple adapter.

Flyer's Kit Bag.- This bag is provided for conveniently carrying and transporting the parachute when not being worn. This bag is constructed of 12-ounce duck, reinforced with linen webbing, and has an interlocking fastener opening.

5. Routine Inspection.

All parachutes that are issued for service are checked for general condition and serviceability at least once every ten days and a record of this inspection is maintained on W.D., A.C. Form No. 58 (Parachute Inspection and Drop-Test Card). This is a responsibility of the operating activity or organization to which the parachutes are issued, and the inspection must be carried on by competent personnel. The checks, which are as complete and thorough as possible without breaking the seal and opening the pack assembly, are made as follows:

a. Note the date of last inspection and repacking, also that of the last drop-test, as entered on W. D., A. C. Form No. 58. If the specified period of these operations has elapsed, the parachute must be withdrawn from service for the accomplishment of the necessary work.

b. Carefully observe the external condition of the pack and harness assembly for any visible defects or deterioration, such as silk protruding at the corners, acid, or oil stains likely to cause deterioration of the contents of the pack, etc. Note particularly the condition of all stitching. Check the harness webbing for damaged or weak spots, and for any rusted or defective harness fittings or snaps.

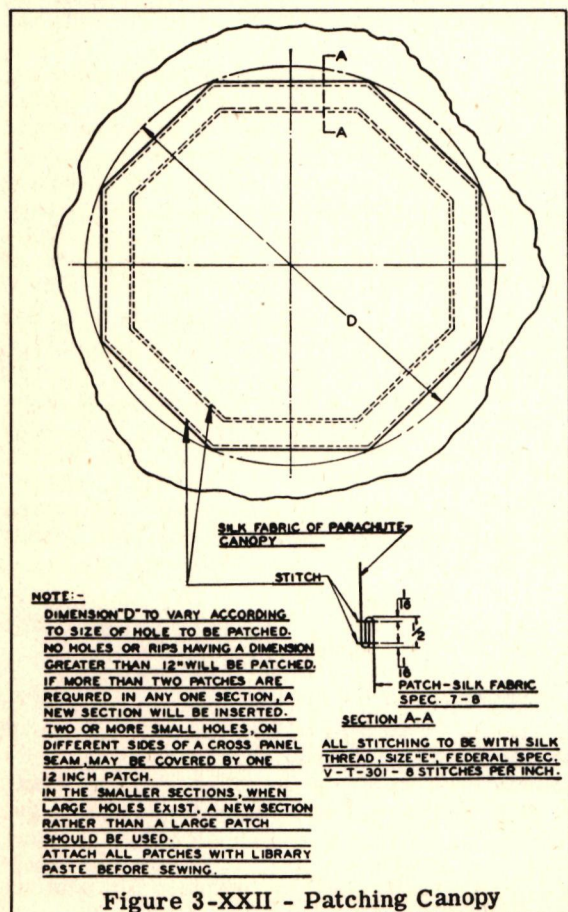


Figure 3-XXII - Patching Canopy

c. Check the condition, elasticity, and proper attachment of the pack-opening elastics.

d. Open the rip cord flap, and note whether or not the rip cord prongs are properly inserted in the cones, that the prongs are not corroded or bent, and that the rip cord seal is intact and properly applied.

e. Grasp the harness webbing at a point on the riser just above the rip cord grip pocket, and jerk mildly against the weight of the pack assembly to see that there is no possibility of the rip cord seal's being broken by excessive stretch or by improper location of the rip cord housing. Also check to see that the rip cord ring pockets hold the ring securely and permit the grip to protrude sufficiently to allow it to be instantly accessible.

f. If, as a result of the foregoing check, any conditions are found that indicate need for repairs or a more thorough inspection irrespective of the date of last repacking, the parachute should be turned over to the parachute department for unpacking and complete inspection before further use.

Complete Inspection. - In order to prolong the life and maintain the reliability of parachutes, they must be carefully inspected at regular intervals, and repaired if necessary. To accomplish this inspection, the parachute is unpacked and stretched out on the folding table where it is secured at points near the apex and just below the suspension line connector links, so that it is held taut. This may be accomplished either by the use of removable "pegs" placed in the folding table to which the various parachute fittings or lines can be attached as required, or by using weights. The harness is placed in the position that it would occupy if its wearer were lying on the table face downward, with his head toward the top of the parachute.

a. The silk of the canopy is inspected for damaged and weak places by carefully looking over each panel and all seams. Mildew, rust, water or oil stains, battery acid, etc., will cause silk fabrics to deteriorate rapidly. If evidence of any of these conditions exists, the necessary repairs must be made, after which, if there is any doubt as to its serviceability, the parachute is drop-tested or reported for overhaul. The condition of the silk is not tested by attempting to tear it and any required patches are applied as shown in fig. 3-XXII.

b. The rubber vent ring of the canopy is inspected and replaced if broken or if deterioration is noticeable. This may be done by removing the stitches of the hem for approximately two inches at the point where the vent ring splice is located and pulling out the old ring. A round molded-rubber strip, approximately 18 inches long, is then inserted and the ends spliced together so that the opening of the vent is four inches in diameter with no appreciable tension in the rubber. The splice is made by lapping the ends of the rubber approximately one inch, and wrapping with one turn of adhesive tape. The adhesive tape is then wrapped with number 16, 3-cord, linen thread. The function of the adhesive tape is to prevent the thread from cutting the rubber.

c. Each suspension line is visually inspected and, if evidence of deterioration is found, the parachute is reported for overhaul. The point at which the suspension lines are attached to the connector links on the harness are particularly observed for evidence of rust. Under no circumstances are suspension lines repaired by means of knots or splices. In the event that any of the lines have been pulled loose from the zigzag lock stitching at the lower main lateral band, the parachute must be sent to the control depot.

d. The silk of the pilot parachute is likewise visually inspected for deterioration and damaged places. Small tears or holes may be repaired by patching. The framework is inspected for breaks and rusted joints, and replaced if not freely operative. The clip on the pilot parachute spring spacer assembly must be checked and resoldered if necessary. Working joints are lubricated with oil, lubricating aircraft, instrument (Specification No. 2-27), to prevent rust and insure operation. After oiling, all excess lubricant must be removed with a clean rag.

e. The pack assembly is carefully inspected visually for any defects or deterioration due to wear in service. Pack assemblies, in which holes have been worn or which show other signs of deterioration, are replaced, except that where the condition of the pack warrants, minor repairs that can be made by stitching, or patching small holes, may be accomplished locally if the necessary facilities are available. Under no circumstances is stitching or patching accomplished while the parachute is packed. Bent or broken frames that cannot be repaired locally are also replaced. Stains from water, oil, etc., which may cause deterioration to the silk are removed by washing the discolored area with warm water and Air Corps specification soap, after which care must be taken to remove all traces of soap by rinsing.

(1) Grommets are inspected and replaced if no longer serviceable.

(2) The cones in which the rip cord prongs are inserted are carefully examined, and all rough places and sharp corners removed. The surface of these cones should be perfectly smooth.

(3) Pack-opening elastics are replaced whenever any indication of deterioration or loss in elasticity is observed. When installing elastics, the hooks on each end are inserted in the eyelets on the pack with the open part toward the pack, and clinched after packing is completed. If the end of a hook is allowed to remain open, it may wear a hole through the pack and foul the pilot parachute.

(4) Worn or damaged seat and back pads must be replaced. Both pneumatic and sponge rubber pads are used for this purpose. In no case is a seat pad sewed to a packed parachute.

(5) Careful inspection of the rip cord housing is made for breakage and for improper attachment to the pack and harness. It should be so secured that, while the rip cord is in place, any stretching of the housing or pulling or jerking of the harness will have no tendency to withdraw the rip cord prongs from the cones. Failure to observe this requirement may result in premature opening when the parachute is being worn. The housing must also be carefully inspected for rust, flexibility, and length. A flexibility and breakage test is made by coiling the housing around a two-inch metal bar or tube. If the housing cracks or takes a permanent set, it is unserviceable. There are two types of housings, the seat-type which is 24-1/4 inches long and the back, 20 inches long. The measured length of a housing has a stretch allowance of 1/2 inch per foot. The chest-type parachute requires no housing.

(6) The rip cord must be inspected to make sure that there are no rust spots and that the wrapping and soldering on the pins is smooth and unbroken. A check must also be made on the pins to see that they are not bent or defective in any way. All rip cord assemblies are inspected for soft locking pins. This inspection can be made by inserting 1/2 inch of the end of the rip cord pin between soft metal lined jaws of a vise or in a jig made by drilling a hole 1/2 inch deep in a soft metal block. A small spring scale is then hooked into the rip cord grip and a seven-pound pull applied at right angles to the pin, being careful that the surface of the pin is not marred in any manner. All pins that take a permanent set are discarded as being too soft. Usually, pins that are too soft can be readily bent with the thumb and index finger of one hand. Rip cord assemblies must not under any circumstances be kept in service in a condition that might create a hazard if their use should be required in an emergency. This applies particularly to the condition of the cord at a point adjacent to the grip, below the solder, for at this point the flexing of the cable tends to break the strands. To guard against the possibility of failure, all rip cords are carefully inspected for broken cable strands, particularly adjacent to the grip, and for any other defects that might indicate failure of the assembly in normal use.

(7) The rip cord-ring pocket must hold the ring securely and permit the rip cord grip to protrude sufficiently to make it instantly accessible. Any pocket that allows the grip to fall out, or holds it so tight that withdrawal is difficult, must be repaired or replaced.

f. The harness is inspected for damaged or weak spots, especially those that may be produced from rust or battery acid. If the harness webbing shows evidence of wear, deterioration, etc., the harness assembly must be replaced. Inspection is made of the stitching and attachment of the harness to the pack. Harness fittings should be examined for breakage, rust, etc., with special attention being given to the condition of harness snaps and fasteners, the tongue and springs of which sometimes become weakened or bent. The rivets that hold the locking spring (tongue) to the female fastener must be properly headed through the fittings. If trouble is found in the fasteners or snaps they must be replaced. Male and female fasteners on parachute harness should be installed in matched pairs to insure perfect freedom of operation.

6. Repacking Intervals.

Parachutes in service in insular possessions are unpacked, completely inspected, and repacked at least once each month; while those in domestic service are repacked at least once every 60 days. Regardless of the date when last inspected and repacked, any packed parachute found with evidence of damage to harness or pack must be unpacked and reinspected before being used. This also applies to any parachute having stains on the pack. Where the stains indicate that water, oil, acid, etc., have been spilled on the assembly, no time should be lost in making the inspection.

7. Folding and Packing.

a. Folding the parachute is a simple operation, but one that must be thoroughly understood.

Both care and accuracy cannot be over-emphasized. A shot bag or hook left in the pack, a knot in one of the suspension lines, or a suspension line dropped while being placed in the pockets are all mistakes easily made, but may result in parachute failure. Each step in the folding and packing of a parachute should be very carefully made, and the operator must direct his undivided attention to the work.

b. It is noted in fig. 4-XXII that there is a space through which a vertical center line can be drawn without intersecting any of the lines representing the suspension lines or harness webbing. The point at which this line intersects the circumference locates the centers of two panels that are referred to as the upper and lower center panels. For convenience in instruction, the suspension lines are shown graphically in this figure and are numbered, beginning with the one at the left of the top center panel, anti-clockwise, completely around the skirt of the canopy. The suspension lines nearest the center line are the principal reference lines when parachutes are correctly laid out for folding (fig. 5-XXII). The service or S-type parachutes are most generally used and will therefore be referred to in the following procedure for folding and packing. The assumption is also made that a type-S seat pack and harness are used although the instructions will apply to the other standard types of parachute assemblies by substituting their suspension line numbers in fig. 5-XXII.

(1) After making the complete inspection, place the connector links of the harness lift webs over dowel pins in the surface of the folding table to hold the parachute taut. Grasp the suspension lines of the right group in one hand and those of the left group in the other and work toward the skirt of the parachute, thus separating the lines into two groups and at the same time dividing the panels. Thus arranged, the top center panel (between lines Nos. 24 and 1) should be on the top, and the bottom center panel (between lines Nos. 12 and 13) should be on the bottom, with lines Nos. 1 to 12, inclusive, in the left-hand group and Nos. 13 to 24 inclusive, in the right-hand group. Next trace suspension lines Nos. 24 and 1 from the skirt of the canopy back to the harness connector links, ascertaining their correct location. Suspension lines Nos. 12 and 13 should be traced in like manner, placing the parachute in position for folding the panels.

(2) Holding the bottom panel in place on the folding table, place the remaining panels of the right group over to the left and properly fold this panel (between lines Nos. 12 and 13) by stretching it out smoothly. All suspension lines should be kept taut during the folding operation. Fold the remaining panels of the right hand group in the same manner, placing the panels directly over each other in their correct order. The last panel of the right-hand group to be thus folded is the one between lines Nos. 23 and 24. After all panels of the right-hand group have been properly folded, place weights on them. Next throw the panels of the left-hand group over those of the right-hand group that have already been folded, so as to expose the bottom panel on the left-hand side, which is the one between lines Nos. 11 and 12. Fold this panel to the left-hand side and fold the remaining panels of the left-hand group in their proper order over this one. The last panel of the left-hand group to be folded is the one between lines Nos. 24 and 1, or the top center panel. All panels are then in their proper position.

(3) Double over each group of panels so that the over-all width of the folded panels is equal to the equivalent width into which the canopy must be placed in the pack. Place weights over these folds in order to hold them in place.

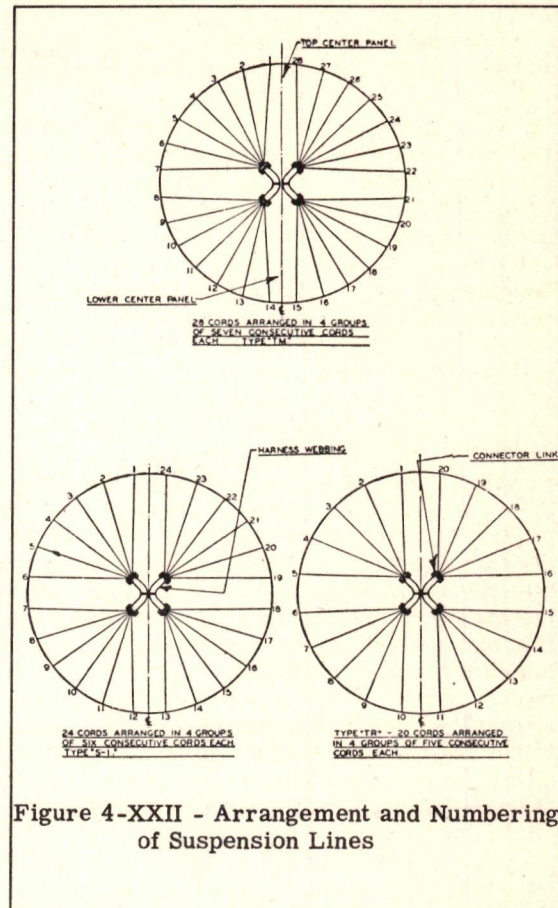


Figure 4-XXII - Arrangement and Numbering of Suspension Lines

(4) Remove the weights from the folded panels, and release the canopy at the apex; then fold it in accordion folds starting at the skirt using the folding tool for this purpose. Make certain that all weights have been removed before continuing.

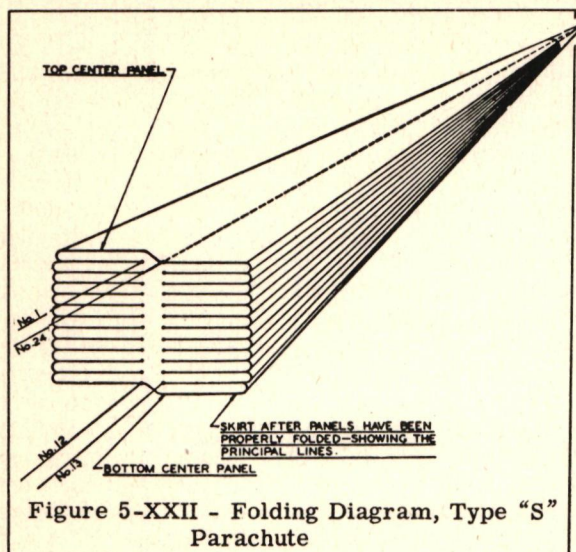


Figure 5-XXII - Folding Diagram, Type "S" Parachute

(5) Place the main lift webs so that they extend across the pack and grasp the suspension lines in one hand. With the other hand, lift the pack and harness assembly to a position adjacent to the skirt end of the folded panels; then draw the suspension lines through the rubber loops provided for them. Leave approximately one foot of the suspension lines free between the canopy and pack and lay them loosely across the lines already located. Make certain that there are no twists or tangles in the suspension lines, as either may cause failure in the opening of the canopy.

(6) Place the folded canopy onto the pack, over the folded suspension lines, with the apex uppermost. Pass 100-pound silk cords through each of the rip cord pin holes of the pack cones and fold over the pilot-parachute flaps. Next, pass the free ends of the 100-pound cords through the grommets in the outer pack flap and,

with the aid of these cords, pull the sides of the pack into position bringing the pack cones into the grommets. Pull the end flaps with the rip cord housing attached into place, bringing the grommet over the cone. Temporarily lock the cones with a spare rip cord, and make certain that the pilot-parachute bridle lines enter the pack on the opposite end from that to which the rip cord housing is attached.

(7) Arrange the pilot-parachute and suspension lines; then fold it by holding the eye loop in one hand, grasping the suspension lines with the other, and thus pulling the frame together. The folded pilot parachute is then inserted in place between the overlap of the parachute flaps. Fold the suspension lines in accordion folds and tuck them under the ends between the overlap of the superimposed flaps. Under no circumstances may any part of the pilot parachute skirt or its suspension lines be wrapped around the outside of the folded frame when packing the assembly.

(8) Carefully tuck the protruding part of the canopy into place and pull the remaining end of the pack up into position (this is also done by the use of a cord through the cone and grommet), again locking the cones in place by means of a spare rip cord. Tuck all flaps in place, using a varnished hardwood stick approximately 12 inches long, 1-1/2 inches wide and 5/16 inch thick, tapered in width and thickness at one end, and with all edges rounded and all surfaces carefully smoothed. Remove all cords used in drawing cones in place. Remove the spare rip cord and install one that has been thoroughly inspected for condition. After inserting the rip cord pins in the cones, seal the end pin by means of one wrap of No. 12, 4-cord, cotton thread (Specification No. VT-276). Securely knot the free ends of the sealing cord and compress a lead seal over the knot and cord. Seals and presses for this purpose are obtained from the control depot, but are only issued locally to authorized parachute maintenance personnel. After the pack is neatly straightened and the flaps are well tucked in place, hook the pack-opening elastics. All hooks are inserted from the outside and clinched after they are in place. Insert the rip cord grip in the pocket provided, making a half twist in the direction of the twist of the cable.

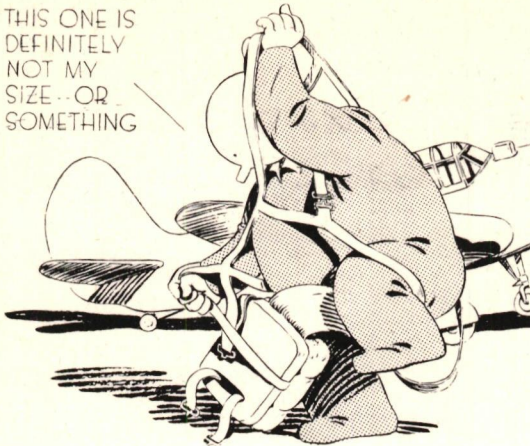
(9) When the foregoing operations have been completed, W.D., A.C. Form No. 58 is accomplished and inserted in the pocket.

8. Fitting and Adjusting Harness.

a. All parachute harnesses must be adjusted to the wearer to provide a snug, comfortable fit and to prevent loose folds of webbing from catching on projections when getting in and out of the airplane. Proper adjustment also prevents the lift webs from slipping off the shoulders.

Fitting of the harness to the wearer is accomplished after the parachute has been properly packed.

THIS ONE IS
DEFINITELY
NOT MY
SIZE--OR
SOMETHING



b. The first operation in adjusting the S, D, and B type harnesses is to place the double shoulder adapter at the top of the shoulders. A triple adjusting adapter is provided on the horizontal back strap and a double adapter on each of the two leg straps. After the back straps have been adjusted to fit the wearer properly, the back triple adapter-fitting should be arranged so as to be on the right side for comfort. Any surplus length of the back-strap webbing is folded back and forth, single-thickness, across the back pad and stitched so that no uncomfortable bundle is formed. The breast straps should be located approximately 12 inches below the chin, where they are securely tacked to the harness lift webs.

c. After all adjustments have been made to fit the wearer, the webbing is tacked with two turns of No. 16, three-cord linen thread. When using this thread for hand sewing, it is doubled and waxed with pure beeswax. The sponge rubber pack pad on the seat-type parachute is fitted so that the thick portion is placed at the small of the wearer's back. It is attached to the harness by stitching to the cross back strap at the shoulder adapters, so that the lift webs are held close to the neck. It is also stitched to the horizontal back strap in the region of the small of the back. The eyelets on the sides of the pneumatic-type back pads are located parallel to the opening of the main lift web by raising and making a plait in the duck of the pad.

d. Adjustment of the leg straps is accomplished by moving the leg strap double adapter back toward the point of attachment on the lift webs, until a snug fit is obtained. If slippage is encountered, the webbing adjacent to the adapter on the left leg of the wearer is tacked with two turns of No. 16, three-cord linen thread. Where sufficient adjustment of the leg straps is not obtainable by this method, further tightening is accomplished by pulling out the loop of the webbing to the rear of the adapter, and tacking it with two turns of No. 16, three-cord linen thread at the points indicated on the right leg of the wearer.

9. Repair and Overhaul.

a. Repair.- The term "repair" applies to such operation as replacing pack assemblies, pack-opening rubbers, harness assemblies, pilot-parachute assemblies, vent rubbers, minor repairs to packs, repairs in stitching (except zigzag stitching in canopy), replacement of harness snaps and fittings, and repair of torn places in the canopy which do not exceed 12 inches in diameter. Such repairs may be accomplished by any activity having qualified personnel and the necessary equipment. Under no circumstances is parachute silk, salvaged from parachutes retired from service due to age or deterioration, used in the repair of active parachute canopies.

b. Overhaul.- The term "overhaul" includes, in addition to the work outlined in above, all major repair operations necessary to place the parachute assembly in first class condition. Overhaul is accomplished by depots only.

(1) Parachutes are forwarded to the control depot for complete inspection and overhaul only as warranted by their condition, the extent of repairs required, or the lack of local repair facilities. Normally, they are forwarded to the depot when their condition, as disclosed by local inspections, indicates the need for repairs beyond the scope of a. above, when they cannot be repaired locally, or whenever doubt exists as to their further serviceability. The date of each depot inspection and overhaul, preceded by the letter "O," is stenciled on the skirt of the canopy. Figures and letters 3/4 inch high are used for this purpose. For example: "O-1-15-39" indicates that overhaul was accomplished January 15, 1939.

(2) Whenever a replacement pack or harness assembly is installed, or when a new parachute assembly on which the required pack and harness dates have not been stamped, is issued,

the date, preceded by the letter "R," is stenciled on the pack and harness, in the following locations, using letters and figures 1/2-inch high.

Harness - On the right-hand front harness web, at its location on the chest.

Pack - On the ripcord protector-flap.

For example: "R-2-15-39" will indicate replacement made February 15, 1939. Normally, unless visibly defective, harness assemblies need only be replaced at the expiration of three years of service except that, in the Panama Canal and Philippine Departments, the service life of harnesses is limited to a maximum of two years.

(3) Certain limitations are placed on the cost of making major parachute repairs. For information in this connection refer to Air Corps Technical Orders.

(4) All parachutes bear, in addition to the markings previously described, the name of the station and individual to whom the parachute is assigned. This information is stenciled in the space provided for this purpose on the back pad.

10. Testing.

a. New parachutes are drop-tested by the contractor prior to delivery and, in the case of overhauls, each parachute is drop-tested by the depot upon completion of the repairs. Subsequent drop-test of parachutes are accomplished at least once every 24 months until the parachute reaches four years of age. Thereafter they are drop-tested at least once each 12 months.

b. Parachutes may be drop-tested with any airplane equipped with external or internal bomb-racks capable of supporting at least 200 pounds. When using external wing racks, the total weight of the dummy and parachute must not exceed 200 pounds. When dropped, the parachute is observed for promptness of opening and for signs of strain or defects to material. Opening should occur within 3-1/2 seconds and all drop-tests should be accomplished with a standard dummy, at a speed of 100 miles per hour. The complete parachute assembly is fastened to the test dummy by means of the regular harness, and the dummy is secured to the bomb rack, head forward, in the same manner as a bomb. The rip cord is secured to the bomb rack by a static parachute test line and the parachute is released from the rack by means of the bomb-release mechanism.

c. After drop-testing, the parachute is given a thorough inspection and repaired where necessary.

d. The date of the parachute drop-test is entered on W.D.,A.C. Form No. 58 (Parachute Inspection and Drop-Test Card) and W.D.,A.C. Form No. 46 (Parachute Record Card).

e. Activities having no facilities for drop-testing parachute must make arrangement with the control depot for the accomplishment of this work.

11. Cleaning.

a. Parachutes that have come in contact with salt water are immediately unpacked, and the canopy and suspension lines rinsed in fresh running water for 10 minutes (soft water being preferable when available), then suspended and allowed to dry for at least 48 hours, or as much longer as is necessary to insure thorough drying. No attempt should be made to wring out the canopy or suspension lines. The harness and pack must be replaced, and disposition made of the removed parts. Such parachutes are carefully inspected before repacking and at each subsequent repacking after being placed in service. If any evidence of abnormal deterioration is apparent, the parachute must be immediately shipped to the control depot for disposition. Parachutes that have been submerged in salt water more than 24 hours should be disposed of.

b. In the event that a canopy becomes badly stained with oil, grease, or other foreign substance, the parachute should be returned to the control depot for cleaning. Slight discoloration of the canopy from oil or grease may be removed by washing the discolored area with lukewarm water and Air Corps Specification soap, followed by a thorough rinsing. Mud or other foreign matter should be removed from the canopy by air drying and brushing. In general, the cleaning

of parachutes should be kept at a minimum, although, when it is considered necessary, it may be accomplished by either dry cleaning or steam cleaning in accordance with Specification No. 20021.

12. Storage and Shipment.

a. Parachutes should be stored in a dry place, protected from the sun's rays, and frequently inspected for evidence of any deterioration. Except those required for current issue, all parachutes must be stored unpacked, preferably by suspending the canopy from the apex. The silk should not be compressed, nor should the pack-opening rubbers be left under tension. Parachutes should never be left packed or placed in storage when in a damp condition. Assemblies in this condition must be thoroughly aired and dried at once.

b. Parachutes are shipped unpacked, with their canopies loosely folded. Within the continental limits of the United States, shipments are made in the flyer's kit bags with the bags inclosed in suitable pasteboard boxes. In the case of shipments to insular possessions, the parachutes are individually wrapped in wrapping paper and shipped in wooden shipping cases which have been lined with water-proof paper. Upon receipt at insular possessions, the parachutes must be promptly inspected. Any instances of parachutes having become contaminated with water must be immediately reported by radio to the Materiel Division.

13. Prevention of Mildew.

Fabrics are particularly susceptible to damage by mildew in regions having a warm, humid climate. Activities in the insular possessions, affected by such climatic conditions, and elsewhere if the presence of mildew is found or suspected, should adhere to the following:

a. All parachutes should be kept as clean as possible, as the propagation of fungi or mold is dependent to some degree on a nutrient, which may be oil, grease, starch, glue, sizing, etc., in the fabric. Any necessary cleaning should be accomplished as previously described.

b. The parachute must be thoroughly dried in a well-ventilated room at normal temperature before packing. The room should be of sufficient height to permit the canopies to be suspended clear of the floor and equipped with fans to increase the flow of air through the drying room.

c. All packed parachutes, not actually being used, should be kept in tight lockers, or bins, at the bottom of which are placed suitable containers for dispensing naphthalene fumes (three pounds of naphthalene flakes, Specification No. R-N-91, to each ten cubic feet of locker space). In most cases, the fumes from the naphthalene flakes penetrate the packed parachute sufficiently to prevent the formation and growth of fungi, although under extreme climatic conditions approximately 1/8 pound of naphthalene flakes may be sprinkled over the folded panels of the canopy, prior to the final folding operation, when the parachute is being repacked.

INSTRUCTIONS FOR USING PARACHUTES

14. General.

a. The use of parachutes by pilots and passengers on all flights in Army aircraft is made mandatory in accordance with AR 95-15.

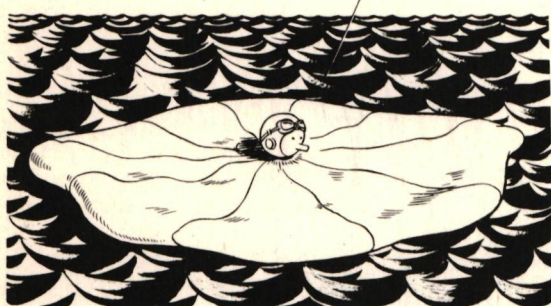
b. Detailed instructions for leaving an airplane under all possible conditions of flight, and particularly for emergency jumps, are not advisable. It has been observed, however, that many jumpers, when leaving an airplane head-first, draw up their legs, which invariably causes a rapid "somersaulting" of the body before the parachute can be released. This often results in the release of the parachute at an instant that it is underneath the wearer. When thus released, one or more suspension lines are occasionally drawn violently over the inflating canopy, resulting in frictional burning of the silk.

c. The rip cord must never be pulled until the jumper is free of the aircraft. Failure to observe this fundamental requirement results in the parachute fouling on the airplane, with resultant hazard not only to the individual, but also the aircraft and remaining occupants. When free of the aircraft, immediately after jumping, the rip cord grip should be firmly grasped and pulled with a quick jerk, pulling the rip cord entirely free from its housing. A quick jerk facilitates complete release more effectively than a slow steady pull.

d. As soon as the parachute has opened following a jump, the suspension lines should be observed for any twists. If twisted, they should be immediately pulled into their proper positions. During the descent, the jumper should attempt to face the direction of the drift. He should also observe closely his distance from the ground, so as to be prepared to absorb the landing shock with his legs partly flexed. Landing in a rigid standing posture, or with the back toward the direction of drift, should never be attempted. Practice or training jumps are made only with the type T training parachutes, and under the condition outlined in AR 95-15. Such jumps are made in not more than a ten mile wind at not less than an altitude of 1,500 feet. The standard circular parachute is not maneuverable and little is accomplished by trying to guide it in any direction.

e. When training or practice jumps are contemplated in the vicinity of bodies of water, the jumper should wear a standard life preserver vest and adequate provision for water rescue must be made before the flight is begun. If, after jumping, it is seen that a landing is going to be made in a body of water, the jumper should settle well back in the harness and unfasten the leg straps. When nearing the water the breast strap should be unfastened and the arms removed from the shoulder straps. When three or four feet from the water the jumper should drop out of the harness. The danger of the canopy falling on the jumper is thus removed since the drift carries it beyond. When landing in a high wind, the jumper upon striking the ground should attempt to run forward towards the parachute and cause it to collapse, preventing his being dragged. Under such conditions, holding back* on the inflated parachute only tends to increase its pull.

THIS PUCKERED VENT WOULD BE EVEN MORE CONVENIENT IN A 14½ COLLAR SIZE

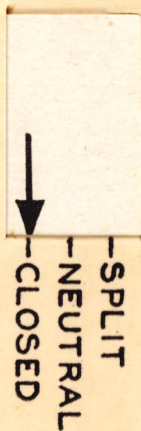


liable to come in contact with acid, oil, or grease.

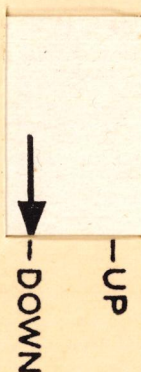
f. When handling parachutes, the following precautionary measures will greatly prolong their life.

- (1) Never pick a parachute up by the riser webs where they enter the pack.
- (2) Never carry a parachute by the rip cord grip.
- (3) Never lay the parachute down with pack next to the ground.
- (4) Never leave the parachute where it is liable to come in contact with acid, oil, or grease.
- (5) Never attempt to adjust the parachute harness in anyway except the regulation of leg straps.
- (6) Never tamper with the rip cord seal.
- (7) Never pull the rip cord before leaving the airplane in the case of an emergency jump.
- (8) Never delay the opening of the parachute in the event of an emergency jump.
- (9) Never use a parachute which has the seal broken or has in any way been tampered with. Turn it in to the parachute department for check.
- (10) Never remove the rip cord grip from the pocket until it is to be used.
- (11) Never tamper with the W. D., A. C. Form No. 58 in the pocket on the pack carrier.
- (12) Never place a parachute in a locker while damp. Turn it in for check by the parachute department.
- (13) Never wear a parachute in flight without having it properly fastened.
- (14) Never allow the parachute harness or any part of the pack to catch on an airplane while entering or leaving.
- (15) Never allow the rip cord protector flap to be opened while wearing a parachute.

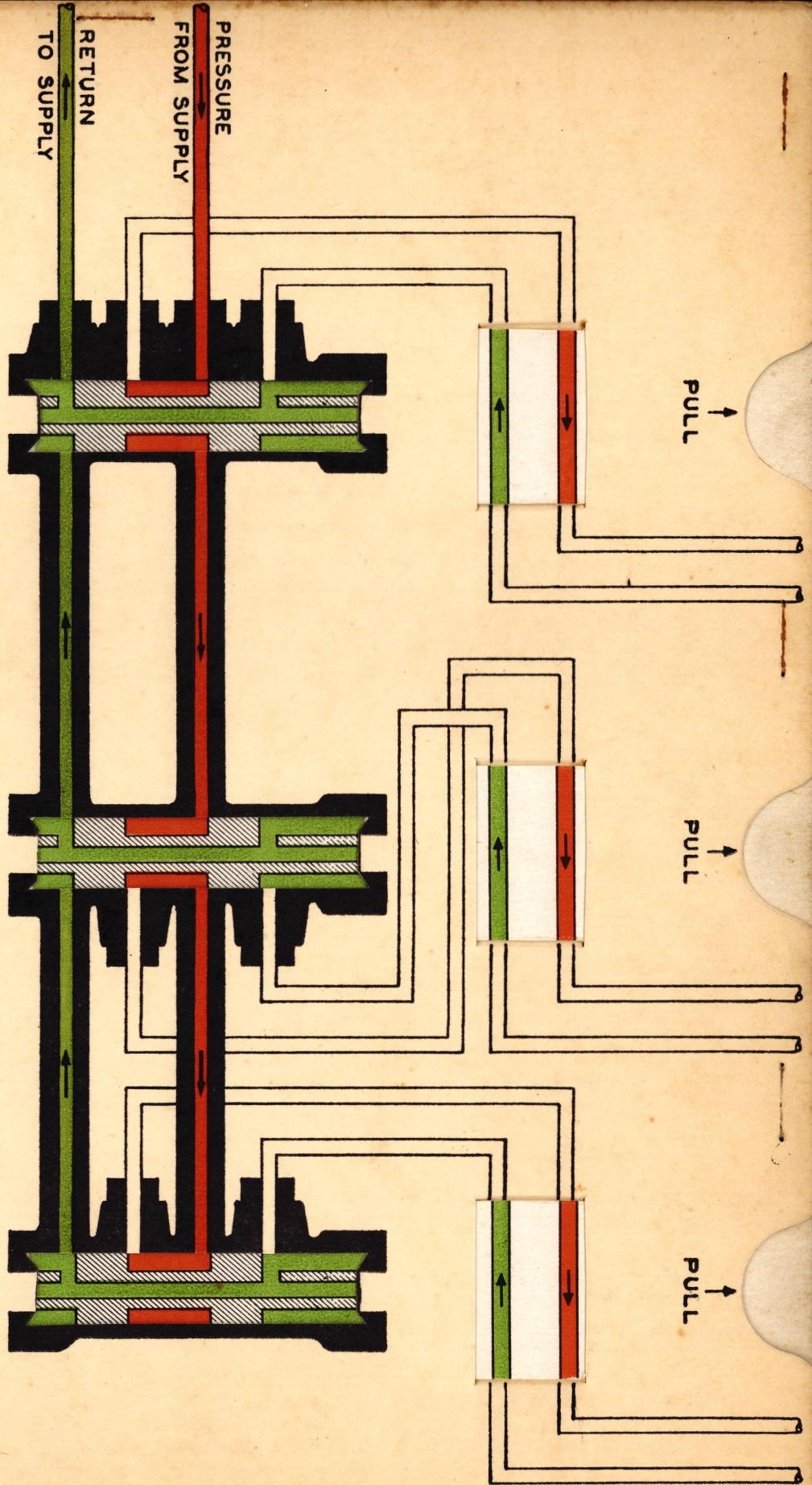
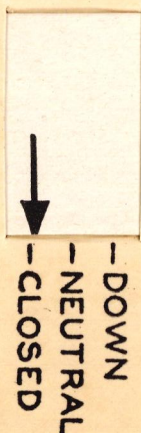
SPLIT FLAP (UPPER)



LANDING GEAR

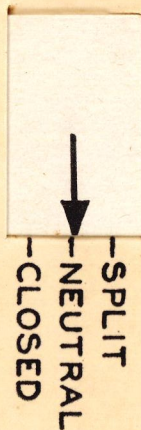


LANDING FLAP (LOWER)



LANDING GEAR AND FLAPS SELECTOR VALVE
OPERATION DEMONSTRATOR

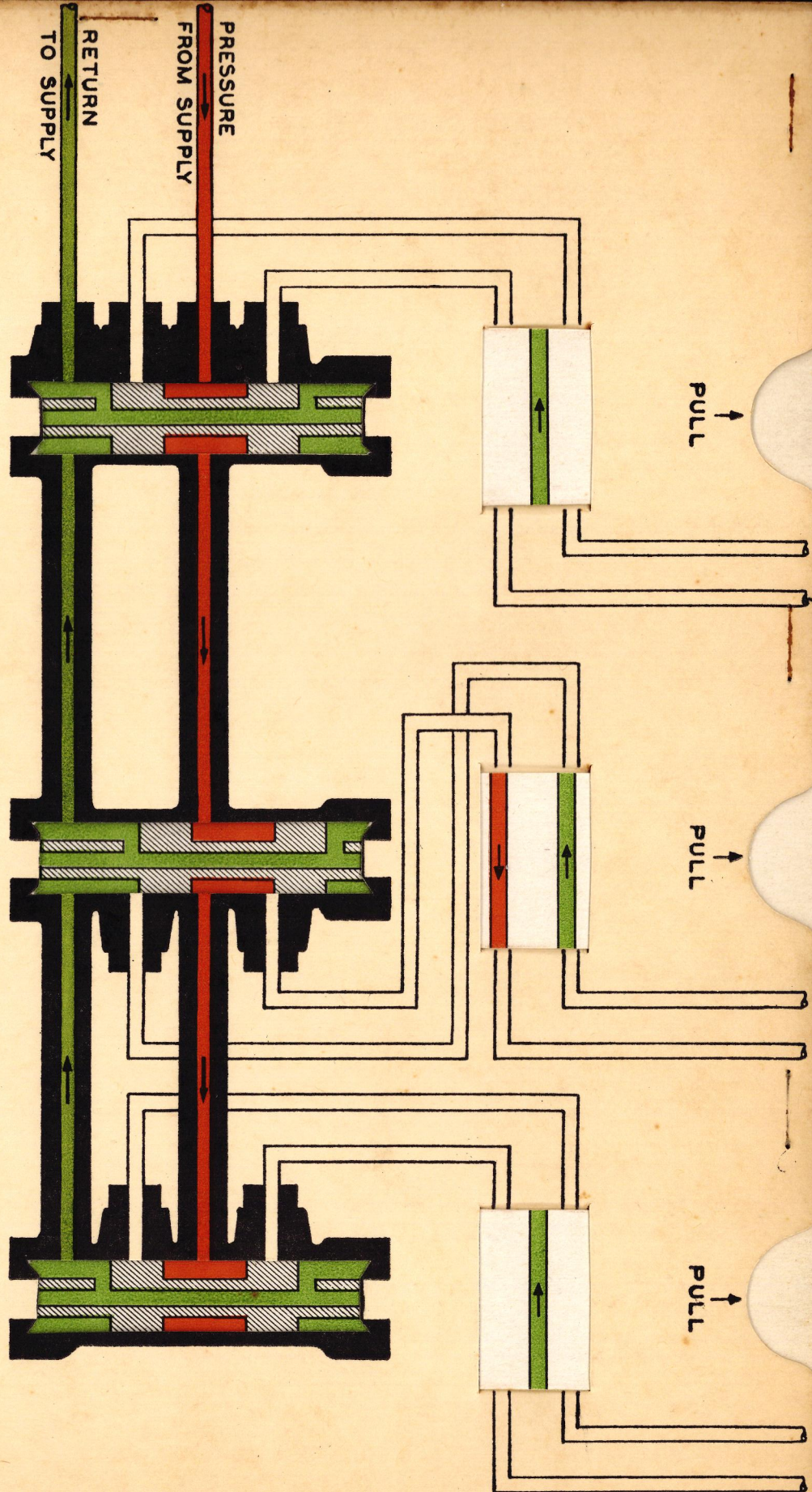
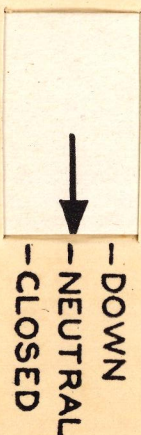
SPLIT FLAP (UPPER)



LANDING GEAR

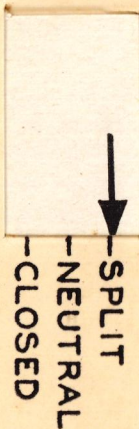


LANDING FLAP (LOWER)

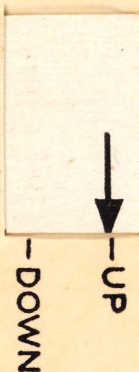


LANDING GEAR AND FLAPS SELECTOR VALVE
OPERATION DEMONSTRATOR

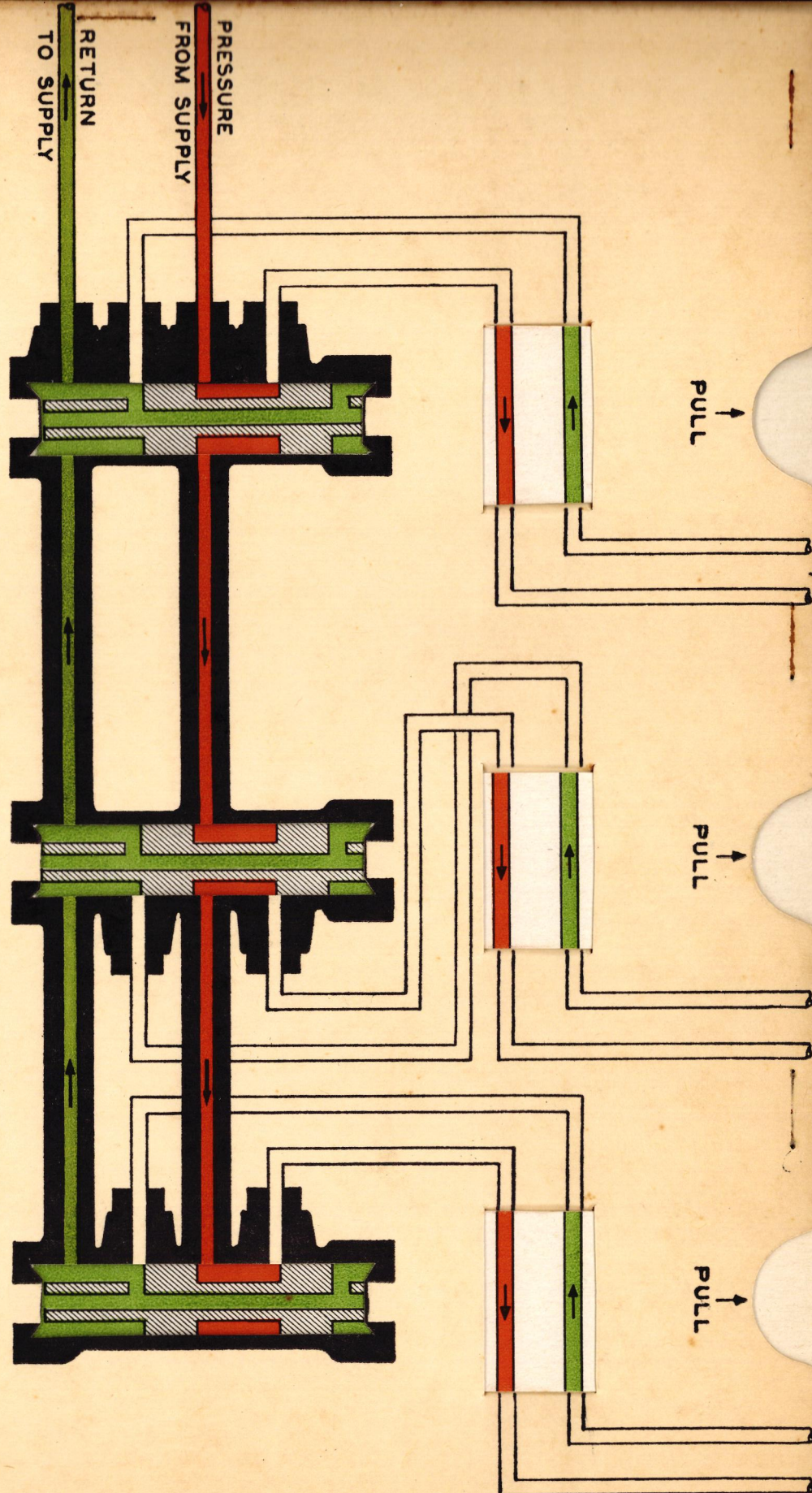
SPLIT FLAP (UPPER)



LANDING GEAR



LANDING FLAP (LOWER)



LANDING GEAR AND FLAPS SELECTOR VALVE
OPERATION DEMONSTRATOR

